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LEVEL
5

Description:

New 4,107 Square Feet Detox facility with Admission's, Client Rooms and medical support services. Remodel of 3,797 Square Feet existing building into a Women's and Family Dormitory.



ARVAC MEDICAL DETOX & CAMPUS

Russellville, Arkansas



04/07/2025



PROJECT MANUAL

ARVAC Inc Medical Detox and Campus Improvements Russellville, Arkansas

April 07, 2025

Bidding and Permitting

Owner

ARVAC, INC
227 Arkansas Highway 333
Russellville, Arkansas 72802
Telephone: 479-219-5292

Architect

Level 5 Architecture
326 Holcomb Street, Suite 101
Springdale, Arkansas 72764
Telephone: 479-756-1661

Structural Engineer

Marc Barry Engineering
860 Wildflower Lane
Rogers, Arkansas 72756
479-936-7600

Mechanical, Electrical, and Plumbing Engineers

Forward Engineers
801 North 24th Street
Rogers, Arkansas 72756
Telephone: 479-282-1028

Civil Engineer

Earthplan Design Alternatives
813 West Meadow Avenue
Springdale, Arkansas 72764
Telephone: 479-756-1266

Level 5 Architecture Project Number:

23-20A

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The specification sections listed below were prepared by or under the direct supervision of the Architect:

Level 5 Architecture
326 Holcomb Street, Suite 101
Springdale, Arkansas 72764

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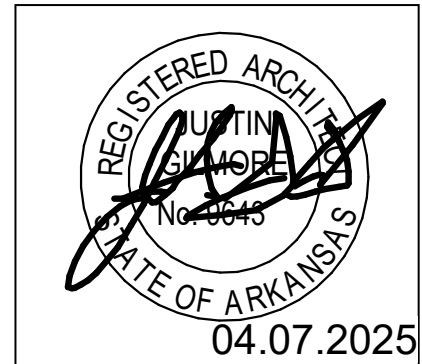
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DOCUMENT 00 11 13 - ADVERTISEMENT FOR BIDS

1.01. OWNER: ARVAC, INC.

1.02. PROJECT: ARVAC, Inc. Medical Detox and Campus Improvements

1.03. DATE: Proposal submissions will be due May 02, 2025 by 2:00 pm
A pre-bid will be held on-site on April 22, 2025, at a time TBD.

1.04. LOCATION: Proposals will be received by the Architecture firm by certified mail or electronic mail:

ATTN: Branson Evans.
Level 5 Architecture
326 Holcom Street
Springdale, Arkansas 72764
Telephone: 479-756-1661
Electronic Mail: branson@level5arch.com

1.05. SCOPE OF WORK:

- A. The work in this project involves New construction of an approximately 4,000 square feet admission and detox facility. Building will be wood framed construction with brick veneer, composite siding, and asphalt shingles.
- B. The Proposer will be responsible for the accomplishment and coordination of all construction activities indicated in the documents.
- C. As Described in the Proposal Documents.

1.06. CONDITIONS:

- A. Proposers shall submit their Proposals and all documentation required by this Request for Proposals in one complete package to the Construction Manager at Risk. Failure to include any part of the requested information or documentation may result in the disqualification of the Proposal
- B. **Proposals shall be submitted to the** Architecture firm on the date and time that the Proposals are due:
 - 1. The Construction Manager at Risk's Proposal Package and ADDITIONAL REQUIRED INFORMATION as requested.
- C. After receiving and qualifying submitted Proposals, the Architecture firm and **ARVAC, Inc.** will evaluate each qualified Proposal. The architect and **ARVAC, Inc.** will select the Proposal that offers the best value for **ARVAC, Inc.**

Contracts will be awarded on the basis of the lowest responsive proposal complying with the conditions of the Proposal Package provided it is in the best interest of **ARVAC, Inc.** and the Construction Manager at Risk. The owner, however, reserves the right to reject any and all proposals and to waive any informality in proposals received whenever any such rejection or waiver is in the best interest of **ARVAC, Inc.** and the architecture firm.

In determining the lowest responsive subcontractor and best value for **ARVAC, Inc.**, the Construction Manager at Risk will evaluate the following items:

- 1) The number of the Base Proposal including each Alternate Proposal if applicable.
- 2) The probability that the Subcontractor can and will perform in accordance with the Proposal and Construction Documents.
- 3) The likelihood that the Subcontractor will deliver the awarded scope per the Construction Manager at Risk and **ARVAC, Inc.** required schedule.

- 4) The reputation and past performance of the Subcontractor including past contracts, subcontractor's proposed personnel, financial ability, and safety record.
- D. Following successful negotiations with the Construction Manager at Risk, the Proposer will be expected to execute a comprehensive Subcontract Agreement indicating the contract value as the final amount agreed upon in negotiations with the Construction Manager at Risk.
- E. The Construction Manager at Risk, can, at its discretion, require the subcontractor to whom the work will be awarded, to supply a Performance and Payment Bond. As such, each proposal shall state on the line provided in the Form of Proposal, the added cost for the bond. If the firm submitting a proposal is unable to supply a Performance and Payment Bond, the words **not available** shall be stated in the line provided. It is important to note that a subcontractor's inability to provide a Performance and Payment Bond will not solely be a determining factor in awarding a contract.
- F. Proposals received after the closing time for whatever reason, will be returned unopened.
- G. No Proposer may withdraw its Proposal within **sixty (60)** calendar days after the actual date of opening.
- H. The Construction Manager at Risk and **ARVAC, Inc.** reserves the right to accept or reject any or all Proposals, and to waive any and all formalities.
- I. Teinert Commercial Building Services, Inc. and **ARVAC, Inc.** are Equal Opportunity Employers.
- J. All inquiries regarding this Request for Competitive Sealed Proposals must be in writing and directed to the Construction Manager at Risk and/or **ARVAC, Inc.**. Questions directed to other agencies or **ARVAC, Inc.** Officials will not receive consideration or a response.

1.07. CONTRACT DOCUMENT ACQUISITION :

- a. Contact Branson Evans for access to plans and specifications.
branson@level5arch.com, 479-756-1661.

END OF DOCUMENT

DOCUMENT 00 11 16 - INVITATION TO BID

1.1 PROJECT INFORMATION

- A. Notice to Bidders: Qualified bidders are invited to submit bids for Project as described in this Document according to the Instructions to Bidders.
- B. Project Identification: ARVAC, Inc. Medical Detox and Campus Improvements.
 - 1. Project Location: 65 Arvac Lane, Russellville, Arkansas 72802.
- C. Owner: ARVAC, INC. 227 Arkansas Highway 333, Russellville, Arkansas 72802.
- D. Architect: Level 5 Architecture. 326 Holcomb Street, Suite 101, Springdale, Arkansas 72764.
- E. Project Description: Project consists of new construction of an approximately 4,000 square feet admission and detox facility. The building will be wood framed construction with brick veneer, composite siding, and asphalt shingles.
- F. Construction Contract: Bids will be received for the following Work:
 - 1. General Contract (all trades).
 - 2. Multiple Contract Project consisting of the following prime contracts:
 - a. General Building Construction.
 - b. Plumbing Construction.
 - c. Mechanical Construction.
 - d. Electrical Construction.

1.2 BID SUBMITTAL AND OPENING

- A. Owner will receive sealed bids until the bid time and date at the location indicated below. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:
 - 1. Bid Date: May 02, 2025.
 - 2. Bid Time: 2:00 p.m., local time.
 - 3. Location: 326 Holcomb Street, Suite 101, Springdale, Arkansas 72764.
- B. Bids will be thereafter opened in the virtual presence of the bidders and read aloud .

1.3 BID SECURITY

- A. Bid security shall be submitted with each bid in the amount of 5 percent of the bid amount. No bids may be withdrawn for a period of 60 days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 PREBID CONFERENCE

- A. A prebid conference for all bidders will be held at 65 ARVAC Lane, Russellville, Arkansas 72802 on April 22, 2025, at a time TBD, local time. Prospective bidders are requested to attend.

1.5 DOCUMENTS

- A. Online Procurement and Contracting Documents: Obtain access after by contacting Architect Online access will be provided to all registered bidders and suppliers.

1.6 TIME OF COMPLETION

- A. Bidders shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.

1.7 BIDDER'S QUALIFICATIONS

- A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. A Performance Bond, a separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder.

END OF DOCUMENT

DOCUMENT 00 21 13 - INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

- A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.
 - 1. A copy of AIA Document A701, "Instructions to Bidders," is bound in this Project Manual.

END OF DOCUMENT

DOCUMENT 00 22 13 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

- A. Instructions to Bidders for Project consist of the following:
 - 1. AIA Document A701, "Instructions to Bidders," a copy of which is bound in this Project Manual.
 - 2. The following Supplementary Instructions to Bidders that modify and add to the requirements of the Instructions to Bidders.

1.2 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, GENERAL

- A. The following supplements modify AIA Document A701, "Instructions to Bidders." Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions to Bidders, unaltered portions of the Instructions to Bidders shall remain in effect.

1.3 ARTICLE 2 - BIDDER'S REPRESENTATIONS

- A. Add Section 2.1.3.1:
 - 1. 2.1.3.1 - The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner.
- B. Add Section 2.1.5:
 - 1. 2.1.5 - The Bidder is a properly licensed Contractor according to the laws and regulations of Authority Having Jurisdiction and meets qualifications indicated in the Procurement and Contracting Documents.
- C. Add Section 2.1.6:
 - 1. 2.1.6 - The Bidder has incorporated into the Bid adequate sums for work performed by installers whose qualifications meet those indicated in the Procurement and Contracting Documents.

1.4 ARTICLE 3 - BIDDING DOCUMENTS

- A. 3.2 - Interpretation or Correction of Procurement and Contracting Documents:
 - 1. Add Section 3.2.2.1:
 - a. 3.2.2.1 - Submit Bidder's Requests for Interpretation using form bound in the Project Manual.
- B. 3.4 - Addenda:
 - 1. Delete Section 3.4.3 and replace with the following:
 - a. 3.4.3 - Addenda may be issued at any time prior to the receipt of bids.
 - 2. Add Section 3.4.4.1:
 - a. 3.4.4.1 - Owner may elect to waive the requirement for acknowledging receipt of 3.4.4 Addenda as follows:
 - 1) 3.4.4.1.1 - Information received as part of the Bid indicates that the Bid, as submitted, reflects modifications to the Procurement and Contracting Documents included in an unacknowledged Addendum.
 - 2) 3.4.4.1.2 - Modifications to the Procurement and Contracting Documents in an unacknowledged Addendum do not, in the opinion of Owner, affect the Contract Sum or Contract Time.

1.5 ARTICLE 4 - BIDDING PROCEDURES

- A. 4.1 - Preparation of Bids:
 - 1. Add Section 4.1.1.1:
 - a. 4.1.1.1 - Printable electronic Bid Forms and related documents are available from Architect.
 - 2. Add Section 4.1.8:
 - a. 4.1.8 - The Bid shall include unit prices when called for by the Procurement and Contracting Documents. Owner may elect to consider unit prices in the determination of award. Unit prices will be incorporated into the Contract.
 - 3. Add Section 4.1.9:
 - a. 4.1.9 - Owner may elect to disqualify a bid due to failure to submit a bid in the form requested, failure to bid requested alternates or unit prices, failure to complete entries in all

blanks in the Bid Form, or inclusion by the Bidder of any alternates, conditions, limitations or provisions not called for.

4. Add Section 4.1.10:
 - a. 4.1.10 - Bids shall include sales and use taxes. Contractors shall show separately with each monthly payment application the sales and use taxes paid by them and their subcontractors in the form indicated. Reimbursement of sales and use taxes, if any, shall be applied for by Owner for the sole benefit of Owner.
 - B. 4.3 - Submission of Bids:
 1. Add Section 4.3.1.2:
 - a. 4.3.1.2 - Include Bidder's Contractor License Number applicable in Project jurisdiction on the face of the sealed bid envelope.
 - C. 4.4 - Modification or Withdrawal of Bids:
 1. Add the following sections to 4.4.2:
 - a. 4.4.2.1 - Such modifications to or withdrawal of a bid may only be made by persons authorized to act on behalf of the Bidder. Authorized persons are those so identified in the Bidder's corporate bylaws, specifically empowered by the Bidder's charter or similar legally binding document acceptable to Owner, or by a power of attorney, signed and dated, describing the scope and limitations of the power of attorney. Make such documentation available to Owner at the time of seeking modifications or withdrawal of the Bid.
 - b. 4.4.2.2 - Owner will consider modifications to a bid written on the sealed bid envelope by authorized persons when such modifications comply with the following: the modification is indicated by a percent or stated amount to be added to or deducted from the Bid; the amount of the Bid itself is not made known by the modification; a signature of the authorized person, along with the time and date of the modification, accompanies the modification. Completion of an unsealed bid form, awaiting final figures from the Bidder, does not require power of attorney due to the evidenced authorization of the Bidder implied by the circumstance of the completion and delivery of the Bid.
 - D. 4.5 - Break-Out Pricing Bid Supplement:
 1. Add Section 4.5:
 - a. 4.5 - Provide detailed cost breakdowns no later than two business days following Architect's request.
 - E. 4.6 - Subcontractors, Suppliers, and Manufacturers List Bid Supplement:
 1. Add Section 4.6:
 - a. 4.6 - Provide list of major subcontractors, suppliers, and manufacturers furnishing or installing products[**on forms provided**] no later than two business days following Architect's request. Include those subcontractors, suppliers, and manufacturers providing work totaling three percent or more of the Bid amount. Do not change subcontractors, suppliers, and manufacturers from those submitted without approval of Architect.
- 1.6 ARTICLE 5 - CONSIDERATION OF BIDS
- A. 5.2 - Rejection of Bids:
 1. Add Section 5.2.1:
 - a. 5.2.1 - Owner reserves the right to reject a bid based on Owner's and Architect's evaluation of qualification information submitted following opening of bids. Owner's evaluation of the Bidder's qualifications will include: status of licensure and record of compliance with licensing requirements, record of quality of completed work, record of Project completion and ability to complete, record of financial management including financial resources available to complete Project and record of timely payment of obligations, record of Project site management including compliance with requirements of authorities having jurisdiction, record of and number of current claims and disputes and the status of their resolution, and qualifications of the Bidder's proposed Project staff and proposed subcontractors.
- 1.7 ARTICLE 6 - POSTBID INFORMATION
- A. 6.1 - Contractor's Qualification Statement:
 1. Add Section 6.1.1:
 - a. 6.1.1 - Submit Contractor's Qualification Statement no later than two business days following Architect's request.

- B. 6.3 - Submittals:
 - 1. Add Section 6.3.1.4:
 - a. 6.3.1.4 - Submit information requested in Sections 6.3.1.1, 6.3.1.2, and 6.3.1.3 no later than two business days following Architect's request.
- 1.8 ARTICLE 7 - PERFORMANCE BOND AND PAYMENT BOND
- A. 7.1 - Bond Requirements:
 - 1. Add Section 7.1.1.1:
 - a. 7.1.1.1 - Both a Performance Bond and a Payment Bond will be required, each in an amount equal to 100 percent of the Contract Sum.
 - B. 7.2 - Time of Delivery and Form of Bonds:
 - 1. Delete the first sentence of Section 7.2.1 and insert the following:
 - a. The Bidder shall deliver the required bonds to Owner no later than 10 days after the date of Notice of Intent to Award and no later than the date of execution of the Contract, whichever occurs first. Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default.
 - 2. Delete Section 7.2.3 and insert the following:
 - a. 7.2.3 - Bonds shall be executed and be in force on the date of the execution of the Contract.
- 1.9 ARTICLE 9 - EXECUTION OF THE CONTRACT
- A. Add Article 9:
 - 1. 9.1.1 - Subsequent to the Notice of Intent to Award, and within 10 days after the prescribed Form of Agreement is presented to the Awardee for signature, the Awardee shall execute and deliver the Agreement to Owner through Architect, in such number of counterparts as Owner may require.
 - 2. 9.1.2 - Owner may deem as a default the failure of the Awardee to execute the Contract and to supply the required bonds when the Agreement is presented for signature within the period of time allowed.
 - 3. 9.1.3 - Unless otherwise indicated in the Procurement and Contracting Documents or the executed Agreement, the date of commencement of the Work shall be the date of the executed Agreement or the date that the Bidder is obligated to deliver the executed Agreement and required bonds to Owner.
 - 4. 9.1.4 - In the event of a default, Owner may declare the amount of the Bid security forfeited and elect to either award the Contract to the next responsible bidder or re-advertise for bids.

END OF DOCUMENT

DOCUMENT 00 25 13 - PREBID MEETINGS

1.1 PREBID MEETING

- A. Architect will conduct a Prebid meeting as indicated below:
 - 1. Meeting Date: April 22, 2025.
 - 2. Meeting Time: 2:00 p.m., local time.
 - 3. Location: 65 ARVAC Lane, Russellville, Arkansas 72802.
- B. Attendance:
 - 1. Prime Bidders: Attendance at Prebid meeting is non-mandatory.
 - 2. Subcontractors: Attendance at Prebid meeting is recommended.
- C. Bidder Questions: Submit written questions to be addressed by April 25, 2025.
- D. Agenda: Prebid meeting agenda will include review of topics that may affect proper preparation and submittal of bids, including the following:
 - 1. Procurement and Contracting Requirements:
 - a. Advertisement for Bids.
 - b. Instructions to Bidders.
 - c. Bidder Qualifications.
 - d. Bonding.
 - e. Insurance.
 - f. Bid Security.
 - g. Bid Form and Attachments.
 - h. Bid Submittal Requirements.
 - i. Bid Submittal Checklist.
 - j. Notice of Award.
 - 2. Communication during Bidding Period:
 - a. Obtaining documents.
 - b. Access to Project Web site.
 - c. Bidder's Requests for Information.
 - d. Bidder's Substitution Request/Prior Approval Request.
 - e. Addenda.
 - 3. Contracting Requirements:
 - a. Agreement.
 - b. The General Conditions.
 - c. The Supplementary Conditions.
 - d. Other Owner requirements.
 - 4. Construction Documents:
 - a. Scopes of Work.
 - b. Temporary Facilities.
 - c. Use of Site.
 - d. Work Restrictions.
 - e. Alternates, Allowances, and Unit Prices.
 - f. Substitutions following award.
 - 5. Separate Contracts:
 - a. Work by Owner.
 - b. Work of Other Contracts.
 - 6. Schedule:
 - a. Project Schedule.
 - b. Contract Time.
 - c. Liquidated Damages.
 - d. Other Bidder Questions.
 - 7. Site/facility visit or walkthrough.
 - 8. Post-Meeting Addendum.
- E. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to attendees and others known by the issuing office to have received a complete set of Procurement and Contracting Documents. Minutes of meeting are issued as Available Information and do not constitute a

modification to the Procurement and Contracting Documents. Modifications to the Procurement and Contracting Documents are issued by written Addendum only.

1. Sign-in Sheet: Minutes will include list of meeting attendees.
2. List of Planholders: Minutes will include list of planholders.

END OF DOCUMENT



REQUEST FOR INTERPRETATION

Project: _____	R.F.I. Number: _____
_____	From: _____
To: _____	Date: _____
_____	A/E Project Number: _____
Re: _____	Contract For: _____

Specification Section: _____	Paragraph: _____	Drawing Reference: _____	Detail: _____
------------------------------	------------------	--------------------------	---------------

Request:

Signed by: _____	Date: _____
------------------	-------------

Response:

☐ Attachments

Response From: _____	To: _____	Date Rec'd: _____	Date Ret'd: _____
----------------------	-----------	-------------------	-------------------

Signed by: _____	Date: _____
------------------	-------------

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

**SECTION 00 31 32
GEOTECHNICAL DATA**

GEOTECHNICAL DATA

- 1.1 This document with its referenced attachments is part of the Procurement and Contracting Requirements for the 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.
- A 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.
 - B A geotechnical report has been prepared by Barret & Associates, dated December 11, 2024. Copy of report is attached.
 - C 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.
 - D 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.

END OF DOCUMENT

Geotechnical Investigation Report
for
ARVAC Medical Building Expansion

December 11, 2024

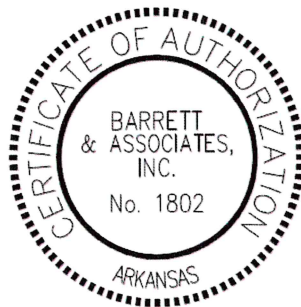
Prepared for:

Level 5 Architecture
Branson Evans
326 Holcomb Street Suite 101
Springdale, AR 72764

Prepared by:



**BARRETT &
ASSOCIATES**
PROFESSIONAL ENGINEERS
LAND SURVEYORS
GEOTECHNICAL SERVICES





**BARRETT &
ASSOCIATES**
PROFESSIONAL ENGINEERS
LAND SURVEYORS
GEOTECHNICAL SERVICES

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APPENDIX B – Bore Logs

APPENDIX C – Atterberg Limits



1.0 SUMMARY

Geotechnical engineering services have been completed for the proposed site for a new medical building at the Lake Point campus in London, AR. The purpose of this reports was to determine the physical and engineering properties of the soils within the area of the proposed construction, and to provide information and engineering recommendations relative to general site characteristics. A series of borings were performed to explore the characteristics of onsite soils and develop a soil profile. Based on the information obtained from our subsurface exploration, it is our opinion that the site can be developed for the proposed project. The following geotechnical considerations were identified:

- Bedrock depth is approximately 7'.
- Site is on a mild slope, creating favorable drainage conditions.
- Onsite soils are acceptable for use, but may be somewhat water sensitive.

This summary should be used in conjunction with the entire report for design purposes. Section 5.0 should be read for a complete understanding of the report limitations.



2.0 INTRODUCTION

This report presents the results of our geotechnical investigation for the new medical building at the Lake Point campus in London, AR.

2.1 Project Description

The proposed building area is located on the Lake Point Campus east of Highway 333. The building site is west of the existing structures along the lakefront and south of the entry drive. The area is currently a mowed field. Drainage is generally sloped from the north to the south lake level. See Appendix A for a site map with bore locations.

2.2 Project Details

Item	Description
Location	See Appendix A.
Topography	Mild slopes typically <10 degrees.
Ground Cover	Mowed grass, tree cover along lakeshore
Improvements	Small outbuilding adjacent to site
Structures	None.
Finished Floor	Final site plan was not available at the time of the report.
Maximum Loads	Columns: 60 kips (assumed) Walls: 2 kips per lineal foot (assumed) Floor Slabs: 150 psf (assumed)
Maximum Allowable Settlement	Total and differential settlement is assumed to be less than one inch.
Grading	Final site plan was not available at the time of the report.
Cut and Fill Slopes	Assumed to be no steeper than 3H:1V



3.0 SUBSURFACE CONDITIONS

3.1 Geology

ATOKA FORMATION

Age: Pennsylvanian Period, Atokan Series

Distribution: In Arkansas the Boston Mountains, Arkansas River Valley, and Ouachita Mountains; eastern Oklahoma, eastern New Mexico, and central and western Texas

Geology: The Atoka Formation is a sequence of marine, mostly tan to gray silty sandstones and grayish-black shales. Some rare calcareous beds and siliceous shales are known. This unit has the largest areal extent of any of the Paleozoic formations in the state. It is the surface rock of the Boston Mountains and dominates the exposures in the Arkansas River Valley and the frontal Ouachita Mountains. It is also present in the southern part of the Ouachita Mountains. In the Arkansas River Valley and the frontal Ouachita Mountains, the Atoka Formation has been subdivided into upper, middle, and lower lithic members based on regionally mappable shale or sandstone intervals. The unit locally contains discontinuous streaks of coal and coaly shale in the Boston Mountains and Arkansas River Valley. Fossil plants, generally poorly preserved, are common throughout the section. Poorly preserved invertebrate fossils are much less common than plant fossils, but have been reported from several horizons. Trace fossils are relatively common in the Atoka Formation. The formation is conformable with the Bloyd Shale in the Boston Mountains and with the Johns Valley Shale in the Ouachita Mountains. The unit may be up to 25,000 feet in thickness in the Ouachita Mountains, although only large incomplete sections are known.

Original reference: J. A. Taff and G. I. Adams, 1900, U. S. Geol. Survey 21st Ann. Rept., pt. 2, p. 273.

Type locality: Named for Atoka, Atoka County, Oklahoma



3.2 Direct Observations

A series of split spoon sample borings were performed. Boring locations were estimated according to the site plan and selected to span the site. Onsite soils were primarily found to be silty clays. Boring logs are attached to this report in Appendix B.

3.3 Stratum Profile

Stratum I: A lightly developed organic zone of shallow grass roots. Typically, 4-6" deep.

Stratum II: Silty clay, variously light brown to light orange.

Stratum III: Silty shale, brownish-gray to black. Transitional weathered shale surface typical.

3.4 Stratum Analysis

The project site did not appear to show signs of being significantly disturbed in the recent past. Historical imagery of the site shows little change in land use in the past few decades. A thin layer of organic soil exists in the zone of root activity for the lawn grasses, typically 4-6" deep. In forested areas along the shore, expect root penetration to be 2-3' deeper. Underlying the topsoil is a light brown silty clay. Borings show this soil profile likely spans most of the site. Some minor variation in particle sizes may occur and reflect similar variation in the source bedrock.

Shale bedrock was encountered in both of the borings. It normally weathers and can form a significant thickness of weaker "brown shale" in a transitional zone. Harder shale bedrock should be found a few feet beyond the weathered material. Fresh silty shale bedrock appears darker gray to black when exposed. If deeper foundations are desired, additional exploration of the bedrock may be necessary.



3.5 Groundwater

The borings were observed for the presence and level of groundwater. Seasonal conditions at the time of investigation affect groundwater level determination. The soils encountered were not saturated. Groundwater was encountered toward the bottom of bore 2, which is likely very close to or below lake level and well within the shale bedrock. Typically, a bedrock layer would act as a barrier for water to collect against. Saturation of the overlying soils, as well as drainage conditions, greatly modify this.

Groundwater level fluctuations occur due to seasonal moisture variations, rainfall amounts, and runoff characteristics. The groundwater levels during construction and at other times in the life of the construction may be higher or lower. Long term observations are best to define the groundwater levels in these soils. Also, perched water could develop in the soil layers and at soil interfaces. Groundwater level fluctuations should be considered during design development and construction operations.



3.6 Seismic

Structure foundations should be designed using guidelines set forth in the 2006 International Building Code. Based upon the soil conditions outlines above, and seismic values for Arkansas published by the Arkansas State Building Services and the 2006 International Building Code, the following is considered applicable to this project site:

Item	Description
Site Class	C
Seismic Zone	1
Soil Profile Type	S
Site Coefficient	1.0
Peak Acceleration Coefficient (Aa)	0.02
Effective Peak velocity related Accelerations Coefficient (Av)	0.09



4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The site presented a uniform soil profile. The silty clays found on site are somewhat suitable for construction. Atterberg limits were performed for the shallow soils and found a plasticity index of 9 and 15. Typically the maximum recommended for construction is 15, so the onsite soils may be a little more water sensitive during construction. Because of this and the overall slope of the site, care should be taken with drainage.

If materials inconsistent with this report are encountered during site preparation and excavation, the engineer should be contacted for review. The risk of unforeseen conditions cannot be eliminated without complete excavation. Additional test pits should be excavated if inconsistent material is encountered. The amount and depth of exploration should be determined in the field by the engineer.

4.2 Earthwork

A site grading plan was not available at the time of preparation of this report. Imported fill is likely to be used on this site. Generally, it is recommended on site soils be distributed to open space areas and imported fill be used under buildings and parking areas. Upon completion of the grading plan, detailed recommendations and depths of removal and replacement can be calculated.

4.2.1 Site Preparation

Surface vegetation, topsoil, existing fill and any other surface or subsurface structures and materials should be removed from the construction areas. Structural use of fill is only generally addressed in this report. Once approved, required fill should be placed and prepared according to the engineered fill material requirements. For any trees within foundation undercut areas, additional undercut and replacement should be performed to remove any remaining stump and root ball with 2 feet of over excavation.

If unstable soils are encountered, full depth removal and replacement with engineered fill is recommended. Recommendations related to unstable soils can be provided during construction if conditions exist. The appropriate method of stabilizations will depend on weather, volume of stabilization, schedule and factors resulting in the instability.



4.2.2 Engineered Fill Material Requirements

Engineered fill shall meet the following:

Fill	USCS Classification	Location
Imported	CL, GC, SC LL \leq 45 and PI \leq 15	All locations and elevations
On-Site	LL \leq 45 and PI \leq 15	All locations and elevations
Well Graded Granular	GW/GM	Beneath floor slabs and pavements

Imported fill shall consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill shall not be placed on a frozen subgrade. A sample of imported material should be evaluated and tested by the geotechnical engineer. No shale materials determined to be overly friable or subject to rapid degradation will be allowed.

4.2.3 Compaction Requirements

Item	Description
Thickness	8 inches or less in loose thickness
Compaction	At least 95% of the material's standard proctor maximum dry density
Soils Moisture Content	Within $\pm 2\%$ the optimum value determined by the standard proctor
Granular Material Moisture Content	Variable

The thickness of fill lifts will vary with material selected. Typical fill depths should be a maximum of three times the particle size. The final fill lift thickness can be determined when the material is evaluated by the engineer. Typical bridge lift thicknesses will be greater than above. The engineered fill should be tested during placement for compaction and moisture by the geotechnical engineer. If the area tested does not meet the requirements, it shall be reworked and retested until the specifications are met.



4.2.4 Utility Trench Backfill

Trenches for utilities should be of sufficient width to allow adequate working space for installation and compaction equipment, and shall meet all applicable safety regulations. Flowable fill to backfill narrow trenches should be considered to minimize settlement. If trenches are backfilled with clean granular material, the potential for water infiltration and migration along the trench and to adjacent soils is likely. To reduce this impact, these trenches should be capped with a minimum of 18 inches of cohesive fill in areas not under pavement.

4.2.5 Grading and Drainage

Design grading should allow for drainage away from the building on all sides consistent with the building code requirements of a minimum of 6 inches in 10 feet. Roof drains should discharge into a collection system and/or be directed away from the building. Sidewalks and paving adjacent to the building should be effectively sealed to prevent infiltration to the footing soils and pavement subgrade.

4.3 Foundations

The site should be prepared as recommended by this report. The foundation soils are expected to be tested and approved, and existing fill or engineered fill processed appropriately. If unsuitable bearing conditions in footing excavations are encountered, the excavations should be extended deeper to suitable soils for footing bearing. In lieu of extending the footings, lean concrete or a properly compacted engineered fill could be placed for footing bearing. If engineered fill will be placed, excavation beyond the footings should extend laterally at least 8 inches per foot of excavation depth below the footing base elevation. The over-excavation should be backfilled up to the footing base elevation with engineered fill in accordance with the compaction requirements.



4.3.1 Design recommendations

If select imported fill is utilized, the following recommendations can be used.

Description	Continuous	Column
Net allowable bearing pressure	3000 psf	3000 psf
Minimum width	24 inches	24 inches
Minimum embedment below finished grade for frost protection	12 inches	12 inches
Estimated differential settlement	< 1 inch	<1 inch over 40 feet

If onsite native fill is utilized, the following recommendations can be used.

Description	Continuous	Column
Net allowable bearing pressure	3000 psf	3000 psf
Minimum width	24 inches	24 inches
Minimum embedment below finished grade for frost protection	12 inches	12 inches
Estimated differential settlement	< 1 inch	<1 inch over 40 feet

Anticipate lower bearing capacity values for native materials in saturated conditions.

4.3.2 Construction Considerations

For a successful project, we recommend all earthwork and excavations be observed and tested by Barrett & Associates to evaluate the construction quality and verify soil bearing conditions have been achieved consistent with this report. The evaluation will include dynamic cone penetration testing at different locations, soil and aggregate densities, visual inspections, etc. The actual scope of the testing and evaluation should be determined when final construction plans are complete.

Concrete shall not be placed in excavation with excess water or loose soils. Concrete placement should be as soon as possible upon completion of excavation operations. Efforts should be made to keep truck traffic off the cut areas and materials placement pad prior to and during placement of select fill. Finished floor elevation is designed such that no undercut is necessary; new materials will be placed over the existing aggregates.

Should unstable subgrade conditions develop during construction operations, the affected area should be removed and replaced with engineered fill if in place stabilization is not possible. Subgrade soil moisture content should be maintained throughout construction.



Excavations shall comply with all applicable safety regulations. Subsurface water migration through or around the site may occur. The geotechnical engineer should be retained during construction to observe earthwork and perform necessary testing.

4.4 Slabs

On grade floor slabs should be placed on properly prepared subgrade consisting of existing soils or engineered fill meeting all requirements and observed and tested by Barrett & Associates. An aggregate base course serving as a capillary break should be placed between the slab and subgrade. A 4 inch minimum aggregate base course, or as required by design should be provided.

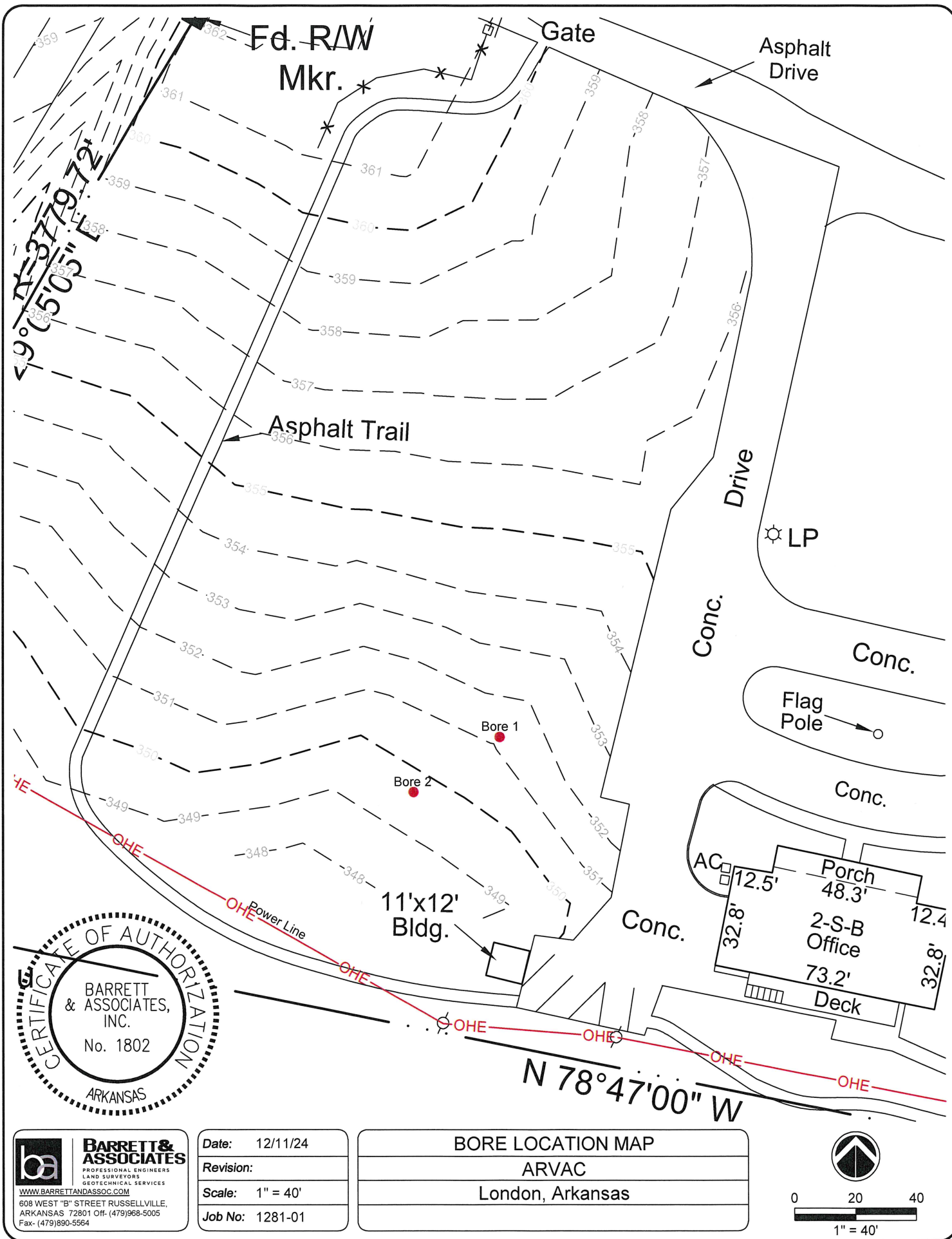
Control joints should be saw-cut in the slab to minimize random cracking. A soft-cut saw is recommended. Joint spacing should comply with the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound. A vapor retarder should be placed beneath the concrete slabs on grade that will receive floor coverings that are moisture sensitive or impervious. The use and placement of a vapor retarder should comply with ACI 302 and/or ACI 360. If water beneath the slab is a concern, a below slab drain system should be considered.

5.0 General Comments

The recommendations presented in this report are based upon the data obtained during the site explorations and other references contained within. The explorations used to prepare these recommendations represent a small portion of the entire site. This report does not account for variations across the site or variations due to weather and/or construction. The variations, if any, may not become evident until excavation and other construction operations begin. If variations appear, Barrett & Associates should be contacted for further evaluation and supplemental recommendations.

Barrett & Associates should be retained to review final design plans and specification to ensure recommendations contained in this report have been incorporated effectively. Barrett & Associates should be retained to provide construction observation and testing services during all earth related construction activities.

APPENDIX A



APPENDIX B

LOG OF BORING

PROJECT: ARVAC FACILITY
 RUSSELLVILLE, ARKANSAS
FOR: BARRETT & ASSOCIATES, INC.

BORING NO: B1

LOCATION: SEE PLAN OF BORINGS

DATE: 12/03/24

JOB NO: 17646

BORING TYPE: AUGER W/SPT

DRILLER: J. SUTTON
 SIMCO 2400

GEOTECHNICIAN: BLACKLOCK

GROUND ELEVATION: NOT FURNISHED

Depth In Feet	Sample Type & No	N-Blows Per Foot	Graphic Symbol	LEGEND		
				S Shelby Tube	NV Diamond Core	P Penetration Test
				■ Core	⊠ Standard Penetration	▢ J - Jar
				▼ Static Water Table	▼ Hydrostatic Water Table	⊔ No Recovery
VISUAL DESCRIPTION OF STRATUM						
0	P1	14		8.0 INCHES TOPSOIL STIFF TO HARD MOIST BROWN SILTY CLAY (CL) PP = 1.50 KSF		
	P2	50/5"		CONTINUES SILTY (CL) PP = 4.5+ KSF		
5	P3	48		CONTINUES SILTY (CL) - BECOMES BROWNISH GRAY PP = 4.5+ KSF		
	P4	50/6"		MODERATELY HARD WEATHERED BROWNISH GRAY SHALE WITH CLAY SEAMS		
10	P5	50/2"		CONTINUES SHALE WITH CLAY SEAMS		
15	P6	50/0"		CONTINUES SHALE - BECOMES GRAY		
20	P7	50/0"		CONTINUES SHALE		
				BOTTOM OF HOLE AT 20.0 FEET. BORING REMAINED OPEN. NO WATER ENCOUNTERED IN THIS BORING.		
25						

LOG OF BORING

PROJECT: ARVAC FACILITY
 RUSSELLVILLE, ARKANSAS
FOR: BARRETT & ASSOCIATES, INC.

BORING NO: B2**LOCATION:** SEE PLAN OF BORINGS**DATE:** 12/03/24**JOB NO:** 17646**BORING TYPE:** AUGER W/SPT

DRILLER: J. SUTTON
 SIMCO 2400

GEOTECHNICIAN: BLACKLOCK**GROUND ELEVATION:** NOT FURNISHED

Depth In Feet	Sample Type & No	N-Blows Per Foot	Graphic Symbol	LEGEND		
				S Shelby Tube	NV Diamond Core	P Penetration Test
				Core	Standard Penetration	J - Jar
				Static Water Table	Hydrostatic Water Table	No Recovery
VISUAL DESCRIPTION OF STRATUM						
0	P1	6		8.0 INCHES TOPSOIL MEDIUM STIFF TO HARD MOIST BROWN SILTY CLAY (CL) PP = 0.75 KSF		
	P2	18		CONTINUES SILTY (CL) - BECOMES BROWNISH GRAY PP = 2.00 KSF		
5	P3	52		CONTINUES SILTY (CL) PP = 4.5+ KSF		
	P4	50/6"		CONTINUES SILTY (CL) PP = 4.5+ KSF		
10	P5	50/5"		MODERATELY HARD WEATHERED BROWNISH GRAY SHALE		
15	P6	50/0"		CONTINUES SHALE - BECOMES GRAY		
20	P7	50/0"		CONTINUES SHALE		
25				BOTTOM OF HOLE AT 20.0 FEET. BORING REMAINED OPEN. WATER ENCOUNTERED AT 18.0 FEET DURING DRILLING. WATER ENCOUNTERED AT 15.0 FEET DURING DRILLING.		

APPENDIX C



**BARRETT &
ASSOCIATES**
PROFESSIONAL ENGINEERS
LAND SURVEYORS
GEOTECHNICAL SERVICES

Atterberg Limits

AASHTO T89 T90

Project: ARVAC

Source: Bore 1 soils <5' depth

Date: 12/11/2024

Description:

Sampled By: Andrew Ashlock

Silty Clay

Tested By: Andrew Ashlock

Liquid Limit Test	
Container No:	G
Number of Blows	26
Verification	25
Container Weight	207.74
Wt. of Container & Wet Soil	222.52
Wt. of Container & Dry Soil	218.4
Wt. of Wet Soil	14.78
Wt. of Dry Soil	10.66
Water Content	38.65
K Factor	1
Final Liquid Limit (LL):	39

K Factors	
N	k
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014

Method A

Plastic Limit Test	
Container No:	G
Container Weight	210.8
Wt. of Container & Wet Soil	223.34
Wt. of Container & Dry Soil	220.88
Wt. of Wet Soil	12.54
Wt. of Dry Soil	10.08
Percent Moisture	24.40
Final Plastic Limit (PL):	24

Calculations: (Liquid Limit) - (Plastic Limit) = (Plasticity Index)

Plasticity Index = 15

Performed by: Andrew Ashlock, Geotechnician

CTTP #: 3233

Signature: A. Ashlock

B&A Lab Job #: GL-24-053

608 West B Street, Russellville, AR 72801 - P. 479-968-5005 - F. 479-890-5564



**BARRETT &
ASSOCIATES**
PROFESSIONAL ENGINEERS
LAND SURVEYORS
GEOTECHNICAL SERVICES

Atterberg Limits

AASHTO T89 T90

Project: ARVAC

Source: Bore 2 soils <5' depth

Date: 12/11/2024

Description:

Sampled By: Andrew Ashlock

Silty Clay

Tested By: Andrew Ashlock

Liquid Limit Test	
Container No:	G
Number of Blows	24
Verification	25
Container Weight	212.61
Wt. of Container & Wet Soil	229.81
Wt. of Container & Dry Soil	225.96
Wt. of Wet Soil	17.2
Wt. of Dry Soil	13.35
Water Content	28.84
K Factor	1
Final Liquid Limit (LL):	29

K Factors	
N	k
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014

Method A

Plastic Limit Test	
Container No:	G
Container Weight	214.86
Wt. of Container & Wet Soil	226.91
Wt. of Container & Dry Soil	224.87
Wt. of Wet Soil	12.05
Wt. of Dry Soil	10.01
Percent Moisture	20.38
Final Plastic Limit (PL):	20

Calculations: (Liquid Limit) - (Plastic Limit) = (Plasticity Index)

Plasticity Index = 9

Performed by: Andrew Ashlock, Geotechnician

CTTP #: 3233

Signature: A. Ashlock

B&A Lab Job #: GL-24-053

608 West B Street, Russellville, AR 72801 - P. 479-968-5005 - F. 479-890-5564

DOCUMENT 00 41 00 - BID FORM

DATE: [_____]

TO: [_____]

RE: [_____]

Gentlemen:

Pursuant to the Instruction to Bidders, the undersigned has thoroughly examined the Bidding Documents and the Site, understands the work to be done, and hereby proposes to do all the work as provided in the Bidding Documents and subject to the observation and approval of the Owner and Architect, and binds themselves on acceptance of this bid by Owner for performing and completing the said work within the time stated and to furnish all required guarantees for the following prices:

BASE BID

For the construction of the additions to the [_____] and including all labor, materials, services, and equipment necessary for the completion of the Work as indicated in the construction documents.

The Sum of _____ DOLLARS

ALTERNATES

Alternate No. 1: [_____]

The Sum of _____ DOLLARS

Alternate No. 2: [_____]

The Sum of _____ DOLLARS

Alternate No. 3: [_____]

The Sum of _____ DOLLARS

Alternate No. 4: [_____]

The Sum of _____ DOLLARS

Alternate No. 5: [_____]

The Sum of _____ DOLLARS

EXTRA WORK FEES

The undersigned agrees that for additional work added to the Contract and for extra costs resulting from changes in the work, the allowance for overhead and profit combined shall be in accordance with the following schedule, but in no case shall it exceed a maximum of 15 percent, (Overhead shall include payroll taxes and supervision):

A. For the Contractor, for any work provided by his own forces: 10% of the cost.

For the Contractor, for work produced by his subcontractors: 5% of the amount due the subcontractor.

A. The General Contractor shall not be allowed to charge the Owner for "extended overhead" charges relating to change orders or weather delays.

**SECTION 00 70 00
GENERAL CONDITIONS**

RELATED DOCUMENTS

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

GENERAL CONDITIONS

- 2.1 The "General Conditions of the Contract for Construction", AIA Document A201, 2017 edition, Articles 1 through 15 inclusive, is a part of this Contract, and is available for review from the Architect. The General Conditions and all modifications listed in Section 007300 shall apply to all various subcontracts and sub subcontractor.
- 2.2 Refer to Document 007300 for Supplementary Conditions.
- 2.3 Should the general conditions or supplementary conditions be in conflict with the Owner-Contractor agreement, the Owner-Contractor agreement shall govern.

END OF DOCUMENT

**SECTION 00 73 00
SUPPLEMENTARY CONDITIONS**

PART 1 GENERAL

SUMMARY

These Supplementary Conditions amend and supplement the General Conditions Section 007000 and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions that are defined in the General Conditions have the meanings assigned to them in the General Conditions.

MODIFICATIONS TO GENERAL CONDITIONS

The following supplements and modifies the "General Conditions of the Contract for Construction" (AIA Document A201-2017) which is part of the Contract Documents (the "Contract").

Division 01 sections expand and delineate additional requirements contained in the general and supplementary conditions.

ARTICLE 1 GENERAL PROVISIONS

1.1 Basic Definitions

Add the following to subparagraph 1.1.3:

1.1.3.1 Observations by the Owner or Architect of "Work", as defined in subparagraph 1.1.3, shall not include temporary structures, such as scaffolding, lifts, shoring and bracing; nor shall the observations by the Owner or Architect of the "Work" be interpreted to convey responsibility to the Owner or Architect for jobsite safety.

Add the following to subparagraph 1.1.6

1.1.6.2 Division 01 sections apply to all sections of the Specifications.

Add the following to paragraph 1.1:

1.1.9 "Approved equal"; and phrases of similar meaning and intent shall require written approval of the Architect of the product or materials referred to, and no substitution or variation from the requirements of the Specification shall be made unless so approved.

1.1.10 "Provide" shall mean, except as otherwise defined, to furnish and install, including delivery, uncrating, connecting and anchor in place, complete and ready for intended use, as applicable in each instance.

1.1.11 "Furnish" shall mean to supply and/or fabricate and deliver material(s) to Site ready for unloading, unpacking, assembling and/or installing, etc. for acceptance by Owner or Architect as applicable in each instance except as otherwise defined.

1.1.12 "Install" shall describe, except as otherwise defined, operations at the project site including receiving, uncrating, unloading, unpacking, assembling, erecting, placing, connecting, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, adjusting, testing (if required), placing, and similar operations, as applicable in each instance, that complete and ready the item(s) for its intended use(s).

1.1.13 "Installer" shall refer to the entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit or erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

1.1.14 "By others", "by Owner", "NIC" (Not In Contract), or "existing" indicates work not required to be done by this Contractor under this Contract.

1.1.15 "Current" or "latest", when used in regard to building codes and manufacturer's instructions, shall mean the edition in effect as of the date of the contract documents, unless otherwise specified or noted.

1.2 Correlation And Intent Of The Contract Documents

Add the following to paragraph 1.2:

1.2.4 Should any contradiction, ambiguity, error or inconsistency appear in or between any of the Contract Documents, the Contractor shall, before proceeding with the Work in question, notify the Architect and request an interpretation. In no case shall he proceed with the affected Work until advised by the Architect.

1.2.5 If the Contractor fails to make a request for interpretation of errors, discrepancies or conflicts in the Drawings or Specifications, no excuse will be accepted for failure to carry out the work in a satisfactory manner, as interpreted by the Architect. In all cases, the Contractor will be deemed to have estimated on the highest quality materials and most expensive way of doing Work unless he has asked for and obtained written decision as to which methods or materials will be required.

1.2.6 Each and every trade or subcontractor will be deemed to have familiarized itself with existing conditions and Drawings of this Project, including Architectural, Mechanical, and Electrical Work, so as to avoid errors, omissions, and misinterpretations. No additional compensation will be authorized for alleged errors, omissions and misinterpretations, whether they are a result of failure to observe this requirement or not.

1.2.7 The Contract Documents are complementary and what is required by any one shall be as binding as if required by all. Portions of the Work which can best be illustrated by the Drawings may not be included in the Specifications, and portions best described by Specification may not be depicted on the Drawings. All items necessary to erect a complete project or to complete work specified under each separate contract, shall be provided whether specified or shown.

1.2.8 The Specifications and Drawings include the entire project. Where items of material, equipment and labor are referred to in the singular, such item or items shall be provided in the quantity necessary for the proper completion of the project.

1.2.9 Wherein existing field conditions are visible, i.e., accessible through normal methods of observation and investigation, and such observed conditions are at variance with or are not indicated on the Drawings, the Contractor and all his subcontractors shall be held to have verified such conditions and have accounted for same.

ARTICLE 2 OWNER

2.3 Information And Services Required Of Owner

Delete subparagraph 2.3.6 and substitute the following:

2.3.6 The Architect shall make available to the Contractor, PDF files of the Drawings and Specifications for download from the designated information exchange website. Contractor shall reproduce, at his own expense, prints he and his subcontractors, suppliers and others require to perform the Work. BIM models will also be made available upon submission of request form.

ARTICLE 3 CONTRACTOR

3.2 Review Of Contract Documents And Field Conditions By Contractor

3.2.2 Add the following to subparagraph 3.2.2:

3.2.2.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Owner pursuant to subparagraph 2.2.3, within thirty (30) days after award of Contract, and shall at once report to the Architect errors, inconsistencies or omissions discovered.

3.2.2.2 If a dimensional discrepancy exists, Contractor shall take field measurements required for proper fabrication and installation of work. Upon commencement of any item of work, Contractor shall be responsible for dimensions related to such item of Work and shall make any corrections necessary to make work properly fit at no additional cost to Owner.

3.2.2.3 Before ordering any material or doing any work, Contractor shall verify dimensions and check conditions in order to assure himself that they properly reflect those on the Drawings. Any inconsistency shall be brought to attention of the Architect. In the event that discrepancies occur between ordered material and actual conditions, of which Architect was not notified beforehand, costs to correct such discrepancies shall be borne by Contractor.

3.4 Labor And Materials

3.4.1 Add the following to subparagraph 3.4.1:

3.4.1.1 All materials shall be delivered and stored in authorized locations in unopened containers and in ample quantity to prevent delay. Ordering of materials shall be made well in advance so as not to hinder the progress of work. Manufacturer's directions for storage and use shall be carefully read and followed. Grade marks, labels, etc., shall be kept readable.

Add the following to subparagraph 3.4.2:

3.4.2.1 After the Contract has been executed the Owner and the Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in the General Requirements (Division 01 of the Specifications), only for items not specifically listed as "No Substitutions Permitted", and only as approved in writing by both the Owner and the Architect.

3.4.2.2 Substitutions shall be made only upon written approval of the Architect and Owner. In all cases, the Architect and Owner shall be the sole judge as to whether a proposed product is to be approved, and the Contractor shall have the burden of proving that substitutions proposed are equal to the items specified, to the satisfaction of the Architect and Owner.

3.4.2.3 The Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Architect in considering a product proposed by the Contractor or by reason of the Architect's failure to approve a product proposed by the Contractor.

3.8 Allowances

Add the following to paragraph 3.8:

3.8.4 The contractor shall waive all claims for additional costs related to allowance items such as permit fees, tap fees, etc. whose amounts are not specifically identified in the Bid Proposal or documents or contracts.

3.11 Documents And Samples At The Site

Add the following to paragraph 3.11:

3.11.1 The "Record" set of Drawings and Specifications shall be neatly and accurately maintained up to date at all times. All changes of every type and nature shall be recorded on the Drawings or noted in the Specifications in the form of typewritten memoranda inserted before each Section, listing all materials and equipment which are actually furnished and installed. The information given in the Specifications shall include the manufacturer's and supplier's names and addresses, brand name, size and style, model or catalog number and all other information necessary to identify each item completely as installed.

3.13 Use Of Site

Add the following to paragraph 3.13:

3.13.1 The Contractor shall store materials on the site and in such a manner which will not damage the grounds. Material deliveries shall be scheduled so that materials are not stored any longer than necessary. All items furnished to the site by the Owner shall be stored as directed.

ARTICLE 4 ARCHITECT

4.1 General

In the second line of subparagraph 4.1.2, delete "Contractor" in its entirety.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 Owners Right To Perform Construction And To Award Separate Contracts

Add the following subparagraph:

6.1.5 Coordinated construction work under this Contract includes, but not be limited to, providing concealed blocking as noted for attachment of separate contract items in locations necessary for the actual items to be installed. Providing proper dimensional coordination of separate contract supplied items for general construction work and trim that is to meet and/or adjoin Furniture, Fixtures, Equipment and Accessories.

6.1.6 It is a requirement of the Contractor's work schedule to provide the cooperation, coordination and exchange of information necessary for a timely execution of separate contract work.

ARTICLE 7 CHANGES IN THE WORK

7.2 Change Orders

Add the following subparagraphs:

7.2.2 Change order proposals shall be accompanied by itemized breakdowns. Breakdowns shall include not only General Contractor's itemizations but also those of subcontractors and vendors. Labor rates shall be actual rates paid including only those fringes and taxes actually paid and supported by records.

7.2.3 Except as provided in this article, no oral statement, or direction of Architect or Owner shall be treated as a Change Order or entitle Contractor to an adjustment to the Contract Sum or the Contract Time.

ARTICLE 8 TIME

8.2 Progress And Completion

Add the following subparagraph:

8.2.4 The Owner shall have the right to occupy, without prejudice the rights of either party, any completed or largely completed portions of the structure or work, notwithstanding the fact that time for completing entire Work or such portions thereof may not have expired. Such occupancy and use shall not be an acceptance of that portion of the work taken or used. Prior to occupying space Owner, Architect and Contractor shall document condition of the work.

8.3 DELAYS AND EXTENSION OF TIME

Add the following to subparagraphs:

8.3.4 Apart from extension of time, no payment or claim for damages shall be made to Contractor as compensation for damages for any ordinary delays or hindrances from any cause whatsoever in the progress of the Work, notwithstanding whether such delay be avoidable or unavoidable.

8.3.5 In order to claim an inclement weather delay day, Contractor must:

8.3.5.1 Document, in writing, that the weather on the particular day was of such nature (rain, wind, snow, ice, and subsequent resultant effects) that it significantly impacted its ability to make progress on critical path work items. Inclement weather delay days will not be granted for weekends or holidays unless Contractor can demonstrate that it had been and intended to work on these days.

8.3.5.2 Submit such delay claims on a weekly basis, not more than 7 days following the day of occurrence.

8.3.5.3 Summarize the number of days claimed for the entire month accompanying each month's application for payment

ARTICLE 9 PAYMENTS AND COMPLETION

Add the following subparagraph:

9.3.4 Unless otherwise stated in the Owner-Contractor Agreement, the Owner will retain, until Final Payment, 10 percent of the amount due the Contractor on account of progress payments, payable 30 days after Substantial Completion and/or satisfactory evidence to the owner that all payments, bills, and claims have been paid.

9.3.5 Monthly Applications for Payment shall include waivers of liens for all work included in previous months' application for payment. Waiver of Liens for subcontractors and materialmen shall be total amount paid prior to previous months' application for payment.

9.5 Decisions To Withhold Certification

Add following Sub-subparagraphs to Subparagraph 9.5.1:

Failure to submit written plan indicating action by Contractor to regain time schedule for completion of Work within Contract Time.

Failure to keep record documents and sustainable submittals current.

9.10 Final Completion And Final Payment

Add the following new paragraph

9.10.2.1 In addition to the items listed in 9.10.2, the Contractor shall deliver (in electronic form) the following items to the Owner before final payment will be made:

1. Other close-out submittals as specified in Division 01.
2. Project record documents as specified in Division 01.
3. Operations and maintenance data as specified in Division 01.
4. All warranties as required on specific products or portions of the Work, in format outlined in Division 01.
5. Spare parts, overages, and maintenance materials as outlined in Division 01 and described in the various technical sections.
6. Certificates of occupancy.
7. Copies of all inspection tags from authorities having jurisdiction.
8. Executed Certificate of Substantial Completion.

ARTICLE 11 INSURANCE AND BONDS

11.1 Contractor's Insurance And Bonds

Add the following subparagraphs:

11.1.5 Within ten (10) days after execution of the Contract and prior to commencement of the work, Contractor must provide a certificate of insurance evidencing the required insurance and naming the Owner as additional insured. The work shall not commence and no payment on the contract will be made by the Owner until all insurance certificates have been filed and accepted by the Owner. The certificate must also indicate that the insurance carried by the Contractor is primary and non-contributing with any insurance coverages of the Owner. The certificate is to contain a thirty (30) day cancellation or material change in coverage. If the Contractor employs subcontractors, the Contractor must obtain certificates of insurance evidencing compliance with the same requirements specified above.

11.1.6 The Contractor must procure and maintain the following insurance coverage naming the Owner, as additional insureds. The insurance policies must be maintained with insurance companies licensed to do business in the state where the property is located.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

DOCUMENT 00 80 04 DAVIS BACON WAGE DETERMINATION

General Decision Number: AR20250109 01/03/2025

Superseded General Decision Number: AR20240109

State: Arkansas

Construction Type: Residential

County: Benton County in Arkansas.

RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single family homes and apartments up to and including 4 stories).

Note: Contracts subject to the DavisBacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the DavisBacon Act itself, but do not apply to contracts subject only to the DavisBacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:

Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.

If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:

Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at

<http://www.dol.gov/whd/govcontracts>.

Modification Number Publication Date
 0 01/03/2025

PLAS0908004 05/01/2024

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 33.50	18.78

SUAR2008220 11/28/2008

	Rates	Fringes
BRICKLAYER.....	\$ 17.09 **	0.00
CARPENTER, Includes Vinyl Siding Installation.....	\$ 12.36 **	0.00
ELECTRICIAN.....	\$ 15.64 **	0.00
LABORER: Common or General.....	\$ 10.27 **	0.00
LABORER: Landscape.....	\$ 9.33 **	0.00
LABORER: Mason Tender Brick... \$ 9.00 **		0.00
LABORER: Mason Tender Cement/Concrete.....	\$ 10.43 **	0.00
OPERATOR: Asphalt Paver.....	\$ 15.75 **	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 13.25 **	0.00
OPERATOR: Bulldozer.....	\$ 12.75 **	0.00
PAINTER: Brush, Roller and Spray.....	\$ 11.25 **	0.00
PLUMBER.....	\$ 14.16 **	0.00
ROOFER.....	\$ 14.87 **	0.00
TILE SETTER.....	\$ 15.00 **	0.00
TRUCK DRIVER, Includes Dump Truck.....	\$ 11.15 **	0.00

WELDERS Receive rate prescribed for craft performing
 operation to which welding is incidental.

** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the DavisBacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other healthrelated needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other healthrelated needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/governmentcontracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A fourletter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVGOH0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single nonunion rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and nonunion rates. Example: SUFL2022007 6/27/2024. SU indicates the rate is a single nonunion prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R. 1.3(g)(h). Example: SAME2023007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

- a) a survey underlying a wage determination
- b) an existing published wage determination
- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWDOoffice@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

END OF GENERAL DECISION

SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.1 PROJECT

- A. Project Name: Arvac, Inc. Medical Detox and Campus Improvements, Russellville, Arkansas.
- B. Owner's Name: Arvac, Inc., Russellville, Arkansas.
- C. Architect's Name: Level 5 Architecture, Springdale, Arkansas..
- D. Refer to cover sheet for Architect's consultants.
- E. The Project consists of the construction of admissions and detox facility and all associated sitework, as more completely described in the Contract Documents.

1.2 CONTRACT DESCRIPTION

- A. Contract Type: Refer to Owner-Contractor agreement.

1.3 DIVISION 01 SPECIFICATIONS

- A. Division 01 General Requirements expand on the broad provisions of the Conditions of the Contract, and govern the execution of the work of all Sections of the specifications. Division 01 General Requirements specify administrative and procedural requirements relating to execution of the Work, and temporary facilities for use during the construction period.

1.4 WORK BY OWNER

- A. Items noted NIC (Not in Contract) will be supplied and installed by Owner after Substantial Completion.

1.5 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion of each building or portion of a building. Confirm phasing of the work to accommodate Owner's schedule.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.
 - 1. Schedule and substantially complete designated portions of work for Owner's occupancy prior to Substantial Completion of entire Work:
 - 2. Upon Owner occupancy of designated portions of the work, Owner will provide, for occupied areas:
 - a. Operation and maintenance of HVAC and electrical systems.
 - b. Maintenance of designated area.
 - c. Security.

1.6 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Existing building spaces may not be used for storage or materials without Owner approval.
- C. Arrange use of site to allow for:
 - 1. Owner occupancy.
 - 2. Work by Others.
 - 3. Work by Owner.
 - 4. Use of site and premises by the public.
- D. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Price and payment procedures, including:
 - 1. Construction cost log.
 - 2. Procedures for preparation and submittal of applications for progress payments.
 - 3. Procedures for preparation and submittal of application for final payment.
- B. Modification procedures, including:
 - 1. Documentation of modifications in Contract Sum and Contract Time.
 - 2. Modification procedures.
 - 3. Correlation of Contractor submittals based on Contract modifications.

1.2 PRICE PROCEDURES - GENERAL

- A. Contract Cost Log: Establish and maintain a construction cost log, including the status of all Contract Modifications (Change Orders); including those which have been accepted, declined, pending, etc.), the status of requests for information, supplemental instructions, other modification documents, and the status of allowances, including Owner's contingency allowance.

1.3 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values electronically within 15 days after date of Owner-Contractor Agreement.
- D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization.
- E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.4 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
 - 1. Forms filled out by hand will not be accepted.
- C. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Executed Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Percentage of Completion.
 - 9. Balance to Finish.
 - 10. Retainage.
- D. Execute certification by signature of authorized officer.
- E. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- F. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- G. Submit electronic copies of each Application for Payment.
- H. Include the following with the application:
 - 1. Transmittal letter as specified for submittals in Section 01 30 00.
 - 2. Construction progress schedule, revised and current as specified in Section 01 30 00.

3. Conditional release of liens from each Subcontractor and vendor for the current month's payment application, and unconditional release of liens from each Subcontractor and vendor for the previous month's payment application.
4. Project record documents as specified in Section 01 78 00, for review by Owner which will be returned to the Contractor.
5. Affidavits attesting to off-site stored products.
- I. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.5 MODIFICATION PROCEDURES

- A. Contractor is responsible for informing and coordinating others, in Contractor's employ and affected subcontractors, of modifications to the Contract Documents.
- B. Supplemental Instructions: For minor modifications not involving an adjustment to the Contract Sum or Contract Time; Architect will issue instructions directly to Contractor.
 1. Architect's issuance of supplemental instructions may constitute a modification of the Contract Documents involving an adjustment to the Contract Sum or Contract Time. If Architect's supplemental instructions require such a modification of the Contract Documents, notify Owner immediately and prepare a request for change order or other modification according to applicable modification procedures specified in this Section. Owner's approval is required before any action is taken.
- C. Construction Change Directive: For other required modifications, Architect will issue a document signed by Architect and Owner instructing Contractor to proceed with the modification, for subsequent inclusion in a Change Order.
 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 2. Promptly execute the change.
- D. Proposal Request: For modifications for which advance pricing is desired, Architect will issue a document which includes a detailed description of a proposed modification with supplementary or revised drawings and specifications, a modification in Contract Time for executing the modification with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 10 days.
- E. Contractor may propose a change by submitting a request for change order or modification to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors.
 1. Document any requested substitutions in accordance with Section 01 25 00 - Substitution Procedures.
- F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Owner and Architect.
 3. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- G. Substantiation of Costs: Provide full information required for evaluation.
 1. Provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time in accordance with the Agreement.

- e. Credit for deletions from Contract, similarly documented.
 - 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 - 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
 - H. Execution of Change Orders: Contractor will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
 - I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
 - J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - K. Promptly enter changes in Project Record Documents.
- 1.6 APPLICATION FOR FINAL PAYMENT
- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
 - B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 70 00.
 - 2. Receipt of final Certificate of Occupancy from jurisdictional authority.
 - 3. Acceptance of Work by Owner and Architect.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 23 00 - ALTERNATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Description of Alternates.
- B. Procedures for pricing Alternates.
- C. Documentation of changes to Contract Sum and Contract Time.

1.2 GENERAL ALTERNATE REQUIREMENTS

- A. The description of each Alternate is recognized to be incomplete and abbreviated, but requires that each change must be complete for the scope or work affected. Refer to applicable specification Sections and applicable Drawings for the specific requirements of work.
 - 1. Where Drawings and specifications are inconsistent, and the inconsistency was not corrected by Addendum, calculate bid to include the greater quantity and superior quality of work.

1.3 DESCRIPTION OF ALTERNATE REQUIREMENTS

- A. Alternates are defined as alternative products, materials, equipment, systems, methods, units of work, or major elements of construction which may, at Owner's option, be selected for the work in place of corresponding requirements of the Contract Documents. Selection may occur prior to the Contract date, or may be deferred for possible selection at a subsequent date.
- B. Include as part of each Alternate, miscellaneous devices, appurtenances, differences in utility or power requirements, and similar items incidental to or required for complete and functioning installation, whether or not specifically mentioned as part of the alternate description.
- C. Immediately following award of the Contract, prepare and distribute to each entity involved, notification of the status of each Alternate. Indicate whether alternates have been accepted, rejected, or deferred for consideration at a later date. Indicate a complete description of negotiated modifications to described scope of Alternates, if any.

1.4 ACCEPTANCE OF ALTERNATES

- A. Alternates will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.5 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 - Replace designated areas of existing floors of Men's Dorm as indicated on plans:
- B. Alternate No. 2 - Replace designated areas of existing floors of Women and Children's Dorm as indicated on plans:
- C. Alternate No. 3 - Provide new generator, generator pad, and transfer switch for Men's Dorm:
- D. Alternate No. 4 - Provide new generator, generator pad, and transfer switch for Women and Children's Dorm:
- E. Alternate No. 5 - Provide new generator, generator pad and transfer switch for remodeled Women's Dorm:

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.2 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling, and substitution limitations.

1.3 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - c. Other limitations specified in Section 01 60 00.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
 - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 - 3. Architect will notify Contractor in writing of decision to accept or reject request.
- D. Substitution Request Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. Form included in the Project Manual are adequate for this purpose, and must be used; see Section 00 60 00 - Project Forms.
- E. Limit each request to a single proposed substitution item.

1. Submit an electronic document, combining the request form with supporting data into single document.
- 3.2 SUBSTITUTION PROCEDURES DURING CONSTRUCTION
- A. Architect may consider requests for substitution only within 60 days after date established in Notice to Proceed, unless otherwise determined by Architect to be acceptable under extenuating circumstances.
 1. Substitutions will also be considered when a Product, through no fault of Contractor, becomes unavailable or unsuitable due to regulatory change.
 - B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 - C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Other construction by Owner.
 - b. Other unanticipated project considerations.
 - D. Substitutions will not be considered under one or more of the following circumstances:
 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 2. Without a separate written request.
 3. When acceptance will require revisions to Contract Documents.
- 3.3 RESOLUTION
- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
 - B. Architect will notify Contractor in writing of decision to accept or reject request.
 1. Architect's decision following review of proposed substitution will be noted on the submitted form.
- 3.4 ACCEPTANCE
- A. Accepted substitutions modify the Contract, and thereby change the Work of the Project. They will be documented and incorporated into Work of the project by Change Order, or similar instrument provided for in the Conditions of the Contract.
- 3.5 CLOSEOUT ACTIVITIES
- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
 - B. Include completed and approved Substitution Request Forms as part of the Project record.

END OF SECTION

SUBSTITUTION REQUEST FORM

PROJECT: _____

(After Contract Award)

TO: _____

NO. _____

DATE: _____

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

1. SPECIFIED PRODUCT OR SYSTEM

Substitution request for: _____

Specification Section No.: _____ Article/ Paragraph: _____

2. REASON FOR SUBSTITUTION REQUEST

SPECIFIED PRODUCT . . .

Is no longer available.

Is unable to meet project schedule.

Is unsuitable for the designated application.

Cannot interface with adjacent materials.

☐ Is not compatible with adjacent materials.

Cannot provide the specified warranty.

Cannot be constructed as indicated

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

Strike

Lockout

Bankruptcy of manufacturer or supplier

Similar occurrence (explain below)

PROPOSED PRODUCT . . .

Will reduce construction time

Will result in cost savings of

\$ _____ to Project

Is for supplier's convenience

Is for subcontractor's convenience

Other: _____

3. SUPPORTING DATA

Drawings, specifications, product data, performance data, test data, and any other necessary information to facilitate review of the Substitution Request are attached.

Sample is attached.

Sample will be sent if requested.

4. QUALITY COMPARISON

Provide all necessary side-by-side comparative data as required to facilitate review of Substitution Request:

	SPECIFIED PRODUCT	PROPOSED PRODUCT
Manufacturer:	_____	_____
Name / Brand:	_____	_____
Catalog No.:	_____	_____
Vendor:	_____	_____
Variations:	_____	_____

(Add Additional Sheets If Necessary)

Local Distributor or Supplier: _____

Maintenance Service Available: Yes No

Spare Parts Source: _____

Warranty: Yes No _____ Years

5. PREVIOUS INSTALLATIONS

Identification of at least three similar projects on which proposed substitution was used:

PROJECT #1:

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

PROJECT #2:

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

PROJECT #3:

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

6. EFFECT OF SUBSTITUTION

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

Proposed substitution requires dimensional revisions or redesign of architectural, structural, M-E-P, life safety, or other work:

No

Yes (if Yes, attach data explaining revisions)

7. STATEMENT OF CONFORMANCE OF REQUEST TO CONTRACT REQUIREMENTS

Contractor and Subcontractor have investigated the proposed substitution and hereby represent that:

- A. They have personally investigated the proposed substitution and believe that it is equivalent to or superior in all respects to specified product, except as stated above;
- B. The proposed substitution is in compliance with applicable codes and ordinances;
- C. The proposed substitution will provide same warranty as specified for specified product;
- D. They will coordinate the incorporation of the proposed substitution into the Work, and will include modifications to the Work as required to fully integrate the substitution;
- E. They have included complete cost data and implications of the substitution (attached);
- F. They will pay any redesign fees incurred by the Architect or any of the Architect's consultants, and any special inspection costs incurred by the Owner, caused by the use of this product;
- G. They waive all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.
- H. The Architect's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered and Addendum is issued; and that Architect's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.

Contractor: _____

(Name of Contractor)

Date: _____ By: _____

Subcontractor: _____

(Name of Subcontractor)

Date: _____ By: _____

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

8. ARCHITECT'S REVIEW AND ACTION

Substitution is accepted.

Substitution is accepted, with the following comments: _____

Resubmit Substitution Request:

Provide more information in the following areas: _____

Provide proposal indicating amount of savings / credit to Owner

Bidding Contractor shall sign Bidder's Statement of Conformance

Bidding Subcontractor shall sign Bidder's Statement of Conformance

Substitution is not accepted:

Substitution Request received too late.

Substitution Request received directly from subcontractor or supplier.

Substitution Request not submitted in accordance with requirements.

Substitution Request Form is not properly executed.

Substitution Request does not indicate what item is being proposed.

Insufficient information submitted to facilitate proper evaluation.

Proposed product does not appear to comply with specified requirements.

Proposed product will require substantial revisions to Contract Documents.

By: _____

Date: _____

Architect has relied upon the information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

9. OWNER'S REVIEW AND ACTION

Substitution is accepted; Architect to prepare Change Order.

Substitution is not accepted.

Owner will pay Architect directly for redesign fees.

Include Architect's Additional Service fee for implementing the substitution in the Change Order.

By: _____
(Owner/Owner's Representative)

Date: _____

END OF FORM

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Administrative meetings, including:
 - 1. Preconstruction meeting.
 - 2. Progress meetings.
- D. Administrative procedures, including:
 - 1. Progress and documentation photographs.
 - 2. Use of Architect's digital Drawing files.
 - 3. Submittals for review, information, and project closeout.
 - 4. Number of copies of submittals.
 - 5. Requests for Information (RFI) procedures.
 - 6. Submittal procedures.

1.2 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Information (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Meeting Minutes: Submit meeting minutes for each type of meeting as specified in this Section.
- C. Submittal Schedule: Submit submittal schedule according to the requirements specified in this Section.
- D. Progress Reports: Submit periodic progress reports as specified in this Section.
- E. Progress Photographs and Documentation: Submit photographic project documentation as specified in this Section.
 - 1. Requests for Information.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.

1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 2. Contractor and Architect are required to use this service.
 3. It is Contractor's responsibility to submit documents in allowable format.
 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
 - B. Submittal Service: The selected service is: Mutually agreeable to Owner, Architect, and Contractor.
 1. Substitutions: Permitted, subject to approval of Architect.
 - C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.
- 3.2 PRECONSTRUCTION MEETING
- A. Architect will schedule a meeting after Notice to Proceed.
 - B. Attendance Required:
 1. Owner.
 2. Architect.
 3. Contractor.
 4. Other invited participants.
 - C. Minimum Agenda:
 1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds (if applicable) and insurance certificates.
 3. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 4. Submission of initial Submittal schedule.
 5. Submission of list of known or anticipated substitution requests.
 6. Designation of personnel representing the parties to Contract, including Contractor, Owner, and Architect.
 7. Procedures and processing of field decisions, RFI's, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 8. Scheduling.
 - D. Record minutes and distribute electronically within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.
- 3.3 PROGRESS MEETINGS
- A. Schedule and administer meetings throughout progress of the work at weekly intervals, unless otherwise agreed upon and approved by Owner.
 - B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
 - C. Attendance Required:
 1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
 - D. Minimum Agenda:

1. Review minutes of previous meetings.
 2. Review of work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Review of known or anticipated substitution requests.
 8. Modification (Change Order) status.
 9. Review of off-site fabrication and delivery schedules.
 10. Maintenance of progress schedule.
 11. Corrective measures to regain projected schedules.
 12. Planned progress during succeeding work period.
 13. Coordination of projected progress.
 14. Maintenance of quality and work standards.
 15. Effect of proposed changes on progress schedule and coordination.
 16. Other business relating to work.
- E. Record minutes and distribute electronically within two two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.
- 3.4 PROJECT CLOSEOUT MEETING
- A. Specified in Section 01 70 00 - Execution and Closeout Requirements.
- 3.5 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 32 16
- 3.6 PROGRESS PHOTOGRAPHS AND DOCUMENTATION
- A. Submit initial photographs to Owner and Architect, and discuss existing conditions that are a concern of Contractor in relation to proposed new Work.
- B. Take additional photographs as Work progresses, at same locations and from same viewing angles as initial photographs.
- C. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- D. Photography Type: Digital; electronic files; each photograph integrally date-stamped.
- E. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- F. In addition to periodic, recurring views, take photographs of each of the following events:
1. Completion of site clearing.
 2. Excavations in progress.
 3. Foundations in progress and upon completion.
 4. Structural framing in progress and upon completion.
 5. Enclosure of building, upon completion.
 6. Final completion, minimum of ten (10) photos.
- G. Views:
1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 2. Consult with Architect for instructions on views required.
 3. Provide factual presentation.
 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- H. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email.
 2. File Naming: Include project identification, date and time of view, and view identification.
 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.7 DIGITAL DRAWING FILES

- A. Architect's Digital Files: Upon request by Contractor, a digital copy of Project Building Information Model (BIM) or CADD Drawing files will be provided as a courtesy for Contractor's limited use. Such information is not considered to be a part of the Contract Documents.
 1. Use of this information is at Contractor's sole risk.
 2. Report to Architect discrepancies, if any, between published Contract Documents and information provided according to General Conditions and other administrative requirements of the Contract.
 3. Prior to receiving digital files, execute data licensing agreement; Architect's standard form.
 4. Architect is not responsible for updating or maintaining currency of digital drawing files after initially provided to Contractor.
 5. Submittals prepared using any of these files as the primary submittal content without the inclusion of substantial additional content generated by Contractor according to specified requirements for applicable submittals will not be accepted or reviewed by Architect.

3.8 REQUESTS FOR INFORMATION (RFI)

- A. Definition: A request seeking one of the following:
 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 2. Prepare in a format and with content acceptable to Architect.
 3. Prepare using software provided by the Electronic Document Submittal Service.
 4. Combine RFI and its attachments into a single electronic file. PDF format is required.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this Section).
 - b. Approval of substitutions (see Section - 01 60 00 - Product Requirements).
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

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

3.9 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 - 1. Provide initial schedule at first progress meeting, and provide updated and current schedule at each progress meeting.
 - a. Secure Architect's approval of submittal schedule before making any other product-related submittals.
 - 2. Coordinate with Contractor's construction schedule, schedule of values, and facility services coordination requirements.
 - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
 - 4. Include in schedule anticipated dates for each submittal to Architect, required dates of return of reviewed submittal to Contractor, and any required lead times associated with applicable submittals.
 - a. Schedule submittals to expedite the Project, and coordinate submission of related items.

- b. Arrange information to include specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 - 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.
 - b. If Contractor fails to submit a submittal schedule, Contractor will not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.
 - B. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Submit complete package of specified submittals for each product or system, generally associated with an individual specification Section. Partial submittals will not be reviewed, and no delay claim will be considered as the result of a partial submittal being returned for proper resubmittal.
 - 2. Submit all door, frame, and hardware product data, schedules, and other specified submittal information in a single package as specified in Division 08.
- 3.10 SUBMITTALS FOR REVIEW
 - A. When the following are specified in individual Sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
 - B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
 - C. Samples will be reviewed for aesthetic, color, or finish selection as applicable.
 - D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.
- 3.11 SUBMITTALS FOR INFORMATION
 - A. When the following are specified in individual Sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types specified.
 - B. Submit for Architect's knowledge as contract administrator or for Owner.
- 3.12 SUBMITTALS FOR PROJECT CLOSEOUT
 - A. Submit Correction Punch List for Substantial Completion.
 - B. Submit Final Correction Punch List for Substantial Completion.
 - C. When the following are specified in individual Sections, submit at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Maintenance materials.
 - 6. Other types specified.
 - D. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents - Submittals for Review and Information: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Submittals for Review: Submit electronically as specified.
- C. Submittals for Information: Submit electronically as specified.
- D. Samples: Submit the number specified in individual specification Sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.14 SUBMITTAL PROCEDURES - GENERAL

- A. General Requirements:
 - 1. Submit separate packages of submittals for review and submittals for information, when included in the same specification Section.
 - 2. Transmit using approved form.
 - a. Use Contractor's form, subject to prior approval by Architect.
 - 3. Sequentially identify each item. For revised submittals use original number and a sequential combination numerical and alphabetical suffix.
 - 4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - 5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals not bearing Contractor's review stamp, indicating both review and approval, will not be reviewed and be returned for required review.
 - b. Submittals from sources other than Contractor will not be acknowledged, reviewed, or returned.
 - 6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - 7. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. Review time will be extended day-for-day if legal holiday(s) are within the projected review time period.
 - c. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - d. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
 - 8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 - 9. Provide space for Contractor and Architect review stamps.
 - 10. When revised for resubmission, identify all changes made since previous submission. Include brief description or narrative of what and how review comments were addressed.
 - 11. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 - 12. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 - 13. Submittals not reviewed by Contractor will be rejected, and will not be reviewed by Architect. Claims for delay as the result of submittals not reviewed by Contractor will not be allowed.
 - 14. Submittals not requested will be recognized, and will be returned "Not Reviewed".
- B. Product Data Procedures:
 - 1. Submit only information required by individual specification sections.
 - 2. Collect required information into a single submittal.

3. Submit concurrently with related shop drawing submittal.
 4. Do not submit (Material) Safety Data Sheets for materials or products.
 5. Manufacturer's Catalog Submittals: If manufacturer's published catalog information is used as part of a submittal, include only those pages from catalog that are specifically applicable to the proposed products for this Project.
 - a. Clearly identify in the submittal those specific products and components for which review and action is requested.
 - b. Submittals received that do not clearly identify specific applicable products, or that include more pages than those specifically applicable to the subject submittal, will be returned as "not reviewed" and the time for submittal review will not commence until a properly scoped submittal is received by Architect.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings, unless otherwise permitted.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package to Architect's office, unless otherwise specified.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.
- 3.15 SUBMITTAL REVIEW
- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action. See below for actions to be taken.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's Actions:
1. Architect will review each submittal, mark it with appropriate "action," and return it to Contractor within specified time allowance; except when it must be held for coordination, and Contractor is so advised.
 2. Where submittals include materials, products, systems, or manufacturers not specified, approved by Addendum prior to execution of the Contract, or approved in writing in conjunction with the proposed products list submittal specified in Section 01 60 00 - Product Requirements, Architect reserves the right to exceed the specified time allowance to allow sufficient time to determine the acceptability of such items, and no claim for delay by Contractor will be allowed.
 3. Where submittals include a material, product, system, or manufacturer substitution which has not been previously accepted or approved in writing, Architect reserves the right to reject such submittal and require a compliant submittal, or may direct that other action be taken by Contractor to achieve compliance with Contract Documents, and no claim for delay by Contractor will be allowed.
 4. Architect's review is for general conformance only and does not relieve Contractor from full compliance with the Contract Documents.

END OF SECTION

SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.2 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
- D. Submit updated schedule with each Application for Payment.
- E. Submit in PDF format.

1.3 QUALITY ASSURANCE

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

1.4 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Diagram Sheet Size: Maximum 22 x 17 inches (560 x 432 mm).
- C. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PRELIMINARY SCHEDULE

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

3.2 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- D. Provide legend for symbols and abbreviations used.

3.3 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.4 REVIEW AND EVALUATION OF SCHEDULE

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

3.5 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.6 DISTRIBUTION OF SCHEDULE

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

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General quality requirements, including:
 - 1. Submittals.
 - 2. Quality assurance.
 - 3. References and standards.
 - 4. Testing and inspection agencies and services.
- B. Specific quality requirements, including:
 - 1. Contractor's construction-related professional design services.
 - 2. Contractor's design-related professional design services (delegated design work).
 - 3. Control of installation.
 - 4. Mock-ups.
 - 5. Tolerances.
 - 6. Manufacturer's field services.
 - 7. Defect assessment.
- C. Basis of design specifications.

1.2 DEFINITIONS

- A. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
 - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, design professional appropriately licensed in the State in which the Project is located.

1.3 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary falsework for support of spanning or arched structures.
 - 5. Temporary stairs or steps required for construction access only.
 - 6. Temporary hoist(s) and rigging.
 - 7. Investigation of soil conditions to support construction equipment.

1.4 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES (DELEGATED DESIGN WORK)

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions of the Contract for Construction.
- B. Performance and Design Requirements: Where professional design services or certifications by a licensed design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with requirements specified in individual specification Sections.

1. Base design of products and systems on performance and design criteria indicated or specified in individual specification Sections.
 2. Submit a Request for Information to Architect if the criteria indicated or specified are not sufficient to perform required design services.
- C. Scope of Contractor's Professional Design Services is specified in each technical section.
- D. Contractor's Responsibilities:
1. Coordinate design and space requirements with other affected work and Architect.
 2. Review applicable submittals and coordinate selections with Architect.
 3. Receive and unload products and systems at the site; inspect for completeness and for damage.
 4. Handle, store, install, and finish products and systems.
 5. Repair or replace damaged, defective, or missing items.
 6. Arrange for manufacturer's warranties, inspections, and service.
 7. Comply with applicable provisions of Division 01 - General Requirements, specifically including administrative requirements, coordination, quality, regulatory, and product requirements.
 8. Coordinate delegated design work with Sections 07 84 00 - Firestopping, 08 31 00 - Access Doors and Panels, applicable Division 09 painting Sections, and applicable Division 23 HVAC instrumentation and control Sections. Provide work scope specified in these Sections that is applicable to delegated design work.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 2. Include required product data and shop drawings.
 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
 5. Provide additional copies of design data for Architect's design consultants, including but not limited to structural engineer, mechanical engineer, plumbing engineer, and electrical engineer; transmit to each design consultant's address concurrently, if requested by Architect.
- C. Certificates: When specified in individual specification Sections, submit certification by the manufacturer and Architect or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- D. Subcontractor, Trade Contractor and Installer Qualifications: When specified in individual specification Sections, submit qualifications data substantiating specified qualifications; three copies, one of which will be reviewed and returned to Contractor indicating action taken.
- E. Manufacturer's Instructions: When specified in individual specification Sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: When specified in individual specification Sections, submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit report in duplicate within 30 days of observation to Architect for information.
 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

- G. Warranty Documentation: When specified in individual specification Sections, submit specified manufacturer warranty indicating all required inclusions and restricted exclusions, and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

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

1.7 REFERENCES AND STANDARDS

- A. Obtain copies of standards where required by product specification Sections.
 - 1. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.8 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Contractor will employ services of an independent testing agency to perform specified testing, unless otherwise indicated for Owner to provide in Owner-Contractor agreement.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Special Testing and Inspection: It is recognized that specified special testing and inspection program is intended to assist Contractor, Owner, Architect, and jurisdictional authorities in nominal determination of probable compliance with specified requirements for certain elements of the Work. This program is not intended to limit Contractor's standard quality control program.
 - 1. See Section 01 45 33 - Code-Required Special Inspections and Procedures, for special inspection and testing requirements.

1.9 BASIS OF DESIGN SPECIFICATIONS

- A. Individual specification Sections may include a Basis of Design Manufacturer or Product, which forms the basis of the specifications, Drawing details, and other requirements of the Contract Documents. The specified Basis of Design Manufacturer or Product is not intended to exclude other manufacturers, products, or systems which comply with the requirements of the Contract Documents, subject to the provisions and requirements specified in individual specification Sections.
- B. Comply with the administrative requirements for substitutions specified in Section 01 60 00 - Product Requirements for proposed products or systems other than the specified Basis of Design Manufacturer or Product.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONTROL OF INSTALLATION

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

3.2 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship and, if applicable, compliance with moisture management materials, claddings, and fenestrations.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Tests will be performed under provisions identified in this Section and identified in the respective product specification Sections.
- D. Assemble and erect specified items with specified backing materials, attachment and anchorage devices, weather barriers, flashings, sealants, applied coatings, surface treatments, and finishes.
- E. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
- F. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- G. Where mock-up has been accepted by Architect and is specified in product specification Sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.3 TOLERANCES

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

3.4 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment, and inspection of surfaces to receive waterproofing systems as applicable, and to initiate instructions when necessary.
 - 1. Manufacturer's field representative will be required to submit daily reports as specified in this Section, when daily observations and inspections are specified in individual Sections.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.5 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment, with Owner's consent.

END OF SECTION

SECTION 01 41 00 - REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Obtain and pay for required permits, fees, licenses, and inspections as stipulated in the Agreement.
- B. Arrange for required regulatory inspections and approvals.
- C. Verify applicable codes and regulations.
- D. Comply with applicable codes and regulations as stipulated in the Agreement.
 - 1. 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.
 - 2. Contractor is required to promptly report to Architect any nonconformity discovered by or made known to Contractor as a request for information as specified, or in such form as Architect may otherwise require.
- E. Listing of applicable Codes and regulations in this Section is not to be considered complete and all-inclusive; listing refers to primary applicable Codes and regulations only. See Drawings for additional information.

1.2 SUMMARY OF APPLICABLE CODES AND REFERENCE STANDARDS

- A. Federal Regulations (Including but not limited to); currently adopted editions of the following, unless noted otherwise:
 - 1. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
 - 2. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
 - 3. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- B. City or other municipal authority having jurisdiction of the State in which the Project is located. Regulations, and other regulations (including but not limited to); currently adopted editions of the following, unless noted otherwise:
 - 1. Zoning Code: Local jurisdiction.
 - 2. Fire Protection District: Local Jurisdiction.
 - 3. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
 - 4. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 5. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 6. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 7. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 8. ICC (IFGC) - International Fuel Gas Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 9. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 10. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 11. Erosion and Sedimentation Control Regulations: Local jurisdiction, unless otherwise specified.

1.3 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements: Additional regulatory requirements.

1.4 QUALITY ASSURANCE

- A. Become familiar with applicable requirements of codes and regulations.

- B. Verify that substituted materials and equipment used in the Work meet or exceed requirements of applicable codes and regulations.
- C. Contractor's Designer Qualifications: Refer to Section - 01 40 00 - Quality Requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 42 16 - DEFINITIONS AND EXPLANATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section supplements the definitions contained in the General Conditions and other Contract Documents.
- B. Other definitions are included in individual specification Sections.
- C. Limitations: Definitions and explanations are not necessarily complete or exclusive, but are generally applicable to the Work to the extent such definitions or explanations are not stated more explicitly in other provisions of the Contract Documents.

1.2 SPECIFICATION EXPLANATIONS

- A. General: Explanations are provided to assist in understanding format, language, implied requirements and conventions of specification content. None of these explanations will be interpreted to modify the substance of content requirements.
- B. Division 01 General Requirements: Expand on the broad provisions of the Conditions of the Contract, and govern the execution of the work of all Sections of the specifications. Division 01 General Requirements specify administrative and procedural requirements relating to execution of the Work, and temporary facilities for use during the construction period.
- C. Sections and Divisions: The basic unit of specification text is the "Section," each of which is named and numbered. These are organized into related families called "Divisions," which generally conform to the most current edition of "MasterFormat" as published by CSI. Any Section title is not intended to limit meaning or content of Section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of the text.
- D. Imperative Language: Used generally in the Specifications. Except as otherwise specified, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe the responsibilities which must be fulfilled either indirectly by Contractor, or when so noted by others.

1.3 SPECIFICATION CONTENT CONVENTIONS

- A. Overlapping Requirements: Where compliance with two or more industry standards or sets of requirements is specified, and overlapping of those requirements also establishes different or conflicting minimums or levels of quality, the more stringent requirement will be enforced (which is generally the more costly level).
- B. Refer apparently equal but different requirements and uncertainties as to which level of quality is required to Architect for interpretation or decision before proceeding.
- C. Specification Minimum: In every instance, the specified requirement is the minimum to be performed or fulfilled. In complying with minimum requirements, the indicated numeric values are either minimums or maximums as noted or as appropriate for the context of the requirement. Refer instances of uncertainty to Architect for decision.
- D. Abbreviations: The language of the Specifications and elsewhere in the Contract Documents is of the abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual work abbreviations of a self-explanatory nature have been included in the text.
- E. Trade associations and general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular wherever applicable and wherever the full context of the requirements so indicate.
- F. Specialists: In certain instances the Specification text may require that specific work be assigned to certain specialists or expert entities for the performance of those units of the Work. These are specified as requirements on which the Contractor has no choice or option.

1.4 DEFINITIONS

- A. Approve/Approved: Where used in conjunction with Architect's or Architect's consultant response to submittals, requests, applications, inquiries, reports, and claims by Contractor, the meaning of the term "approve" or "approved" will be held to the limitations of Architect's responsibilities and duties as specified in Section 01 30 00 - Administrative Requirements and stipulated in the General Conditions of the Contract. In no case will approval by Architect be interpreted as an assurance to Contractor that the requirements of the Contract Documents have been fulfilled.
- B. By Others: Work performed by entities outside the Contract; interchangeable with "NIC" or "Not in Contract."
- C. Contract Documents: Those documents defined in the Owner-Contractor Agreement (Contract) as applicable to the construction of the Project by Contractor.
 - 1. Refer to General Conditions of the Contract for Construction for broader definition of this term.
- D. Contractor's Option: Where materials, products, systems or methods are specified to be at Contractor's option, the choice of which material, method, product, or system will be used is solely Contractor's. There will be no change in Contract Sum or Time because of such choice.
- E. Directed, Requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Architect", "requested by Architect", etc. However, no such implied meaning will be interpreted to extend Architect's responsibility into Contractor's area of construction supervision.
- F. Drawings: Capitalized term referring to the drawings prepared by Architect and its design consultants, and by any Owner consultants as applicable; bound and published as a sub-set of the Contract Documents as defined in Owner-Contractor Agreement (Contract). Non-capitalized term "drawings" used in the Contract Documents generally refers to other drawings not part of the Contract Documents, unless the context explicitly indicates otherwise.
 - 1. Refer to General Conditions of the Contract for Construction for broader definition of this term.
- G. Equipment: Defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including connections (wiring, piping, etc.).
- H. Final Acceptance: The administrative action taken by Owner authorizing final payment and settlement of the Contract.
 - 1. Refer to General Conditions of the Contract for Construction for broader definition of this term.
- I. Furnish: To supply, deliver, unload, and inspect for damage (by Contractor).
- J. General Requirements: Provisions or requirements of Division 01 specification Sections. General Requirements apply to the entire Work of the Contract and, where so indicated, to other elements of work which are included in the Project. See specification explanations in this Section.
- K. Indicated: Cross reference to details, notes or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar means of recording requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping the reader accomplish the cross reference, and no limitation is intended except as specifically noted.
- L. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use (by Contractor).
- M. Installer: The entity (person or firm) engaged by Contractor or his Subcontractor or Sub-subcontractor for the performance of a particular unit of work at the project site, including installations, erection, application and similar required operations.
- N. Material(s): Defined as products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work.
- O. Not in Contract (NIC): Work performed by entities outside the Contract; interchangeable with "By Others."
- P. Product(s): Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- Q. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the Specifications.

- R. Provide: To furnish and install.
- S. Supply: Same as Furnish.
- T. Testing Agency/Laboratory: An independent entity engaged to perform specific inspections or tests of the Work, either at the project site or elsewhere; and to report and (if required) interpret the results of those inspections or tests.
- U. Work (the Work): Capitalized term referring to the entire scope of work of the Project as defined in the Contract Documents. Non-capitalized term "work" used in the Contract Documents generally refers to work by specific trades or other entities as components or phases of the Work, unless the context explicitly indicates otherwise.
 - 1. Refer to General Conditions of the Contract for Construction for broader definition of this term.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 42 19 - REFERENCE STANDARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements relating to referenced standards.
- B. Reference standards full title and edition date.

1.2 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with the reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

END OF SECTION

SECTION 01 45 33 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Code-required special inspections.
- B. Testing services incidental to special inspections.
- C. Submittals.

1.2 DEFINITIONS

- A. Code or Building Code: ICC (IBC), International Building Code, most recent edition adopted by authority having jurisdiction, including all applicable amendments and supplements without limitation, and specifically Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
 - 1. Special inspections and tests are separate from and independent of tests and inspections conducted by Owner or Contractor for purposes of quality assurance and contract administration.

1.3 REFERENCE STANDARDS

- A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- B. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.
- C. IAS AC291 - Accreditation Criteria for Special Inspection Agencies AC291; 2019.
- D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Special Inspection Reports: After each special inspection, Special Inspector is required to submit at least two copies of report; one to Architect and one to AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of product and specifications Section.
 - f. Location in the Project.
 - g. Type of special inspection.
 - h. Date of special inspection.
 - i. Results of special inspection.
 - j. Compliance with contract documents.
 - 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- C. Fabricator Special Inspection Reports: After each special inspection of fabricated items at fabricator's facility, Special Inspector is required to submit report to Architect and to AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of fabricated item and specification Section.
 - f. Location in the Project.
 - g. Results of special inspection.
 - h. Verification of fabrication and quality control procedures.

- i. Compliance with contract documents.
 - j. Compliance with referenced standards.
 - D. Test Reports: After each test or inspection, Testing Agency is required to submit report to Architect and to AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications Section.
 - f. Location in the Project.
 - g. Type of test or inspection.
 - h. Date of test or inspection.
 - i. Results of test or inspection.
 - j. Compliance with contract documents.
- 1.5 SPECIAL INSPECTION AND TESTING AGENCY
 - A. Owner will employ services of a Special Inspection and Testing Agency to perform inspections and associated testing and sampling required by the building code.
 - B. The Special Inspection and Testing Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
 - C. Owner's employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.
- 1.6 QUALITY ASSURANCE
 - A. Special Inspection Agency Qualifications:
 - 1. Accredited by IAS according to IAS AC291.
 - B. Testing Agency Qualifications:
 - 1. Accredited by IAS according to IAS AC89.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

- 3.1 SPECIAL INSPECTIONS AND TESTING
 - A. The Code requires special inspections and testing of certain materials, components, assemblies, and connections used in constructing the project. Special inspections and testing will be performed in accordance with the Code.
 - B. Special inspections and testing will be performed in accordance with the Code for the following materials and project components:
 - 1. Soils.
- 3.2 SCHEDULE OF SPECIAL INSPECTIONS AND TESTING
 - A. A schedule of required special inspections and testing for structural work is included in the structural Drawings.
 - 1. Additional special inspection and testing requirements are specified in this Section.
- 3.3 CONTRACTOR DUTIES AND RESPONSIBILITIES
 - A. Contractor Responsibilities - General:
 - 1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
 - 2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.

3. Provide incidental labor and facilities:
 - a. To provide access to work to be tested or inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
 - c. To facilitate tests or inspections.
 - d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
5. Re-testing: Performed by same agency if required because of non-conformance to specified requirements, on instructions from Architect.
 - a. Paid by Contractor if required because of non-conformance to specified requirements.

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary facilities, including:
 - 1. Dewatering.
 - 2. Temporary utilities.
 - 3. Temporary telecommunications services.
 - 4. Temporary sanitary facilities.
 - 5. Temporary Controls: Barriers, enclosures, and fencing.
 - 6. Field offices.
- B. Temporary controls on Project site, including:
 - 1. Waste removal facilities and services.
- C. Project identification sign.

1.2 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities and controls.
- B. Maintain temporary facilities in operable condition throughout duration of construction period.

1.3 TEMPORARY UTILITIES

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. New permanent facilities may not be used.
- C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.4 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Personal computer or lap-top computer dedicated to project telecommunications, with necessary software and printer.
 - 2. Telephone Lines: Minimum of one phone line, reserved for project use only.
 - 3. Internet Connections: Minimum of one; 2.4G or faster.
 - 4. Email: Account/address reserved for project use only.

1.5 TEMPORARY SANITARY FACILITIES

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

1.6 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for Owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.7 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide minimum 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.8 EXTERIOR ENCLOSURES

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

1.9 SECURITY

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

1.10 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- F. Do not allow vehicle parking on existing pavement, unless authorized by Owner in writing.

1.11 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Erect on site at location established by Architect.
- C. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 10 persons.
- C. Locate offices a minimum distance of 20 feet (6 m) from structures and permanent site improvements.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 53 00 - MOLD PREVENTION MEASURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements to help prevent mold contamination in construction.

1.2 SUBMITTALS

- A. Reports: Submit reports required in this Section, including but not limited to the following:
 - 1. Sightings of existing mold.
 - 2. Window and storefront testing.
 - 3. Moisture contents of materials.
 - 4. Exterior sealant cracks, damage, and deterioration.

1.3 QUALITY ASSURANCE

- A. Preconstruction Meeting: Review requirements of this Section at Preconstruction Meeting.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Do not bring finish materials into building until building is in a conditioned state. Protect finish materials stored within building. Stage materials off the floor and cover with waterproof, breathable covering. Examples of these materials include, but are not limited to, insulation, gypsum products, wall coverings, carpet, ceiling tile, wood products, etc.
- C. Remove from Project site damaged materials or materials that have become wet. Do not install such materials.

1.5 PROJECT CONDITIONS

- A. Perform daily visual inspections of existing building for new or existing mold. Report sightings of mold to Owner's Representative.
- B. Remove water found within building during construction immediately.
 - 1. Energize lift stations and sump pumps as early in Project as possible. Use temporary pumps if necessary to get water out of building and drain lines.
- C. Ventilation:
 - 1. Seal off return air ducts and diffusers to prevent construction dust and moisture from entering occupied areas and HVAC system.
 - 2. Provide temporary outside air ventilation as building becomes enclosed.
- D. Maintain clean project site, free from hazards, garbage, and debris.
- E. Eating, drinking, and smoking are not permitted within buildings.
- F. Slope perimeter grades, both temporary and final grades, away from building structure. Do not allow water to pool around foundations once framing begins.
- G. Verify that condensate pans drain properly beginning with initial installation.
- H. Flash roof penetrations immediately. Do not allow water to penetrate to floor below.
- I. Seal window openings prior to window installation with plastic or weather barrier to prevent moisture entry.
- J. Cover stored and installed ductwork and installed duct openings with plastic to prevent dust, debris, and moisture from entering ductwork. Repair damaged plastic barrier.
- K. Do not operate air handling equipment below 60 degrees F supply air temperature until building is 100 percent enclosed.
- L. Monitor humidity and temperature for conformance to installation requirements defined by material and equipment manufacturers.
- M. Check moisture content of gypsum board prior to applying finishes. Record findings.

- N. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment which will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 INSTALLATION

- A. Roof Drains: Connect roof drains to risers and storm drainage lines as soon as possible.
- B. Floor Drains: Connect floor drains as soon as possible. Do not cover floor drains with tape or other obstructions during construction. Clean out floor drain lines to mains prior to Substantial Completion.
- C. Wall Assemblies:
 - 1. Install exterior wall insulation and gypsum board only after building is enclosed.
 - 2. Keep bottom of installed gypsum board off floor 1/2 inch.
- D. Cavity Conditions: Clean and inspect cavity conditions prior to covering, sealing, or restricting access. Vacuum clean cavity spaces prior to covering or enclosing.
- E. Plumbing: Pressure test plumbing piping identified as insulated on Project prior to installation of insulation.
- F. Roof Mounted Equipment: Inspect rooftop units and other roof-mounted equipment for signs of rain leaks immediately after first rain. Water test with hose immediately after installation. Seal leaks immediately.
- G. Windows and Storefront: Water test windows to manufacturer's and Project Manual's specifications. Record findings and forward to Owner's Representative.
- H. Sealants: Inspect exterior sealants for cracks, damage, or deterioration. Record findings and forward to Owner's Representative.
- I. HVAC Equipment (Permanent HVAC Equipment Used for Temporary Conditioning of Building During Construction Phases): Change filters and clean ductwork interior to remove dirt, dust, debris, and moisture buildup prior to turning Project over to Owner. Bring humidity to below 50% during installation of interior finishes

3.2 ADJUSTING

- A. Remove damaged materials or materials that have become wet. Replace with new materials.
- B. Upon seeing mold growth, remediate mold in accordance with EPA guidelines.

3.3 DEMONSTRATION

- A. Train and educate Owner's maintenance and operational personnel on use of building systems. Explain how improper operation and shutting down systems during off periods can create mold problems.
- B. Schedule with Owner a review of building for mold problems at 1 year warranty walk-through. Inspect exterior sealants and masonry joints for cracks and other damage or deterioration where water can penetrate building envelope.
- C. Explain to Owner the need for Owner to establish annual building review for mold.

END OF SECTION

SECTION 01 57 13 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 REFERENCE STANDARDS

- A. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

1.3 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP).
 - 1. Also comply with all more stringent requirements of Erosion and Sedimentation Control Manual of the State in which the Project is located.
 - 2. Also comply with all requirements of local jurisdiction for erosion and sedimentation control .
- B. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- C. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
 - 2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- D. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
- E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
 - J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - K. Open Water: Prevent standing water that could become stagnant.
 - L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.
- 1.4 SUBMITTALS
- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
 - B. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance, repair, and corrective action required and accomplished. Include date-stamped photographs of conditions with each inspection report.
 - C. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

- 2.1 MATERIALS
- A. General: See Drawings for materials and other required control measures.

PART 3 EXECUTION

- 3.1 EXAMINATION
- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.
- 3.2 PREPARATION
- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.
- 3.3 SCOPE OF PREVENTIVE MEASURES
- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
 - B. See Drawings for scope and extent of required erosion and sediment control measures.
- 3.4 INSTALLATION
- A. General: Install temporary erosion and sediment controls as indicated on Drawings.
- 3.5 MAINTENANCE
- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
 - B. Repair deficiencies immediately.
 - C. Clean out temporary sediment control structures weekly and relocate soil on site.
 - D. Place sediment in appropriate locations on site; do not remove from site.
- 3.6 CLEAN UP
- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
 - B. Clean out temporary sediment control structures that are to remain as permanent measures.

- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
- C. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.1 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. See Section 01 40 00 - Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Containing lead, asbestos, or other known hazardous substances.
- D. Where other criteria are met, Contractor shall give preference to products that:
 - 1. Are extracted, harvested, and/or manufactured closer to the location of the project.
 - 2. Have longer documented life span under normal use.

2.2 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- D. Products Specified by Naming a Basis of Design Manufacturer or Product with a Provision for Substitutions: Submit a request for substitution for any other manufacturer listed under Other Acceptable Manufacturers, or for a manufacturer not named.
 - 1. Refer to Section 01 40 00 for basis of design specifications requirements.

2.3 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification Sections.
- B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION

3.1 SUBSTITUTION LIMITATIONS

- A. See Section 01 25 00 - Substitution Procedures for general substitution procedures.
- B. Architect may consider requests for substitutions when one or more of the following conditions exist, as determined by Architect. If one or more of the following conditions are determined not to exist, Architect may not consider request further, and may take no action except to record the request and its non-compliance. Consideration may be given if substitution request:
 - 1. Offers Owner substantial advantage in cost, time, energy conservation, or other consideration, after deducting additional responsibilities Owner must assume as the result.
 - 2. Does not require extensive modification of Contract Documents.
 - 3. Is consistent with intent of Contract Documents, and will produce intended work results.
 - 4. Is fully documented and properly submitted.
 - 5. Resolves specified Product being unable to receive required approval by Authority Having Jurisdiction (AHJ), and substitution has received such approval prior to submission.
 - 6. Resolves incompatibility of specified Product with other related Products, and substitution is compatible with related Products.
 - 7. Resolves non-coordination of specified Product with other related Products, and substitution is coordinated with related Products.
 - 8. Provides specified warranty when specified Product cannot be provided with specified warranty.
 - 9. Is proposed for a Product that, through no fault of Contractor, becomes unavailable or unsuitable due to regulatory change.
 - 10. Will be considered if a Product cannot be provided within the Contract Time; Architect will not consider substitution if Product cannot be provided as the result of Contractor's failure to schedule and coordinate the Work as required by Contract Documents.
 - 11. Has been coordinated with and among all affected Subcontractors and other portions of the Work, and is acceptable to all affected Subcontractors.

3.2 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.3 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- I. Comply with manufacturer's warranty conditions, if any.
- J. Do not store products directly on the ground.
- K. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- L. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- M. Prevent contact with material that may cause corrosion, discoloration, or staining.
- N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Execution procedures, including:
 - 1. Examination, preparation, and general installation procedures.
 - 2. Pre-installation meetings.
 - 3. Cutting and patching.
 - 4. Surveying for laying out the work.
 - 5. Cleaning and protection.
- B. Closeout procedures, including:
 - 1. Starting of systems and equipment.
 - 2. Demonstration and instruction of Owner personnel.
 - 3. Project closeout meeting.
 - 4. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- C. General requirements for maintenance service.

1.2 DEFINITIONS

- A. Verify, Field Verify, or Drawing Abbreviation: Use on Drawings or in specifications is intended to alert Contractor that indicated measurement or description of work may not be fully determined without comparing verified dimension in larger context or other dependent measurements due to specific product, actual versus nominal dimensions, or measurements of existing conditions.
 - 1. Notify Architect of discrepancies between dimensions shown and field layout or measurements.

1.3 REFERENCE STANDARDS

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

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
 - 6. Include in Request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Alternatives to cutting and patching.
 - f. Effect on work of Owner or separate Contractor, if applicable.
 - g. Written permission of affected separate Contractor, if applicable.
 - h. Date and time work will be executed.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.5 QUALIFICATIONS

- A. For surveying work, employ a land surveyor licensed in the State in which the Project is located.
- B. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.6 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Perform dewatering activities, as required, for the duration of the project.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
- F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- H. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
- I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.7 ADMINISTRATIVE COORDINATION - GENERAL

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

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

- A. New Materials: As specified in product Sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitutions: For any proposed change in materials, submit request for substitution described in Section 01 25 00 - Substitution Procedures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification Sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

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

3.3 PRE-INSTALLATION MEETINGS

- A. When required in individual specification Sections, convene a pre-installation meeting at the site prior to commencing work of the Section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific Section.
- C. Notify Architect minimum 7 calendar days in advance of proposed meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, Owner, participants, and those affected by decisions made.

3.4 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Locate and protect survey control and reference points.
- D. Control datum for survey is that indicated on Drawings.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- H. Utilize recognized engineering survey practices.
- I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- K. Periodically verify layouts by same means.

- L. Maintain a complete and accurate log of control and survey work as it progresses.

3.5 GENERAL INSTALLATION REQUIREMENTS

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual Sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.6 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials, resulting in clean and neat edges, using masonry saw or core drill. Cutting rigid materials using chisels, impact or pneumatic tools is not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- I. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.7 PROGRESS CLEANING

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

3.8 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification Sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

EXECUTION AND CLOSEOUT REQUIREMENTS

- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.9 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 79 00 - Demonstration and Training.
- B. The amount of time required for instruction on each item of equipment and system is that specified in individual Sections.

3.11 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.12 FINAL CLEANING

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

3.13 PROJECT CLOSEOUT MEETING

- A. Schedule and administer a Project closeout meeting minimum two months before scheduled Date of Substantial Completion, at location mutually agreed upon by Owner, Contractor, and Architect.
- B. Attendance Required: Owner, Contractor, job superintendent, and Architect.
- C. Minimum Agenda:
 - 1. Review specified closeout process, tasks required of respective participants, task scheduling, and deadline dates for each critical path task in the closeout process.
 - 2. Review closeout submittals required and submittal procedures for each.
 - 3. Review maintenance materials requirements and Owner's requirements for delivery and storage.
 - 4. Review final inspection requirements of AHJ and coordination of same.

- 5. Review status of record documentation, and discuss process for completing and distributing record documentation to Owner and Architect.
- D. Record minutes and distribute electronically within two days after meeting to participants and those affected by decisions made.

3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect and Owner.
- B. Notify Architect in writing when work is considered ready for Architect's Substantial Completion inspection.
 - 1. Prerequisite for Substantial Completion: In addition to definition of Substantial Completion in the General Conditions or Agreement, Substantial Completion is not considered achieved until Certificate of Occupancy is issued by primary jurisdictional authority, allowing Owner to fully occupy or utilize building and associated facilities for intended use in all respects.
- C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- D. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- E. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- F. Accompany Owner and Architect on Contractor's preliminary final inspection.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification Sections.
- B. Maintenance Period: As indicated in specification Sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.

END OF SECTION

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- C. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- D. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site electronic documents for record document purposes; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product Section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
 - F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish main floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract Drawings.
- 3.2 OPERATION AND MAINTENANCE DATA
- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
 - B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
 - C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- 3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES
- A. For Each Product, Applied Material, and Finish:
 1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products, if any.
 - B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
 - C. Additional information as specified in individual product specification Sections.
 - D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- 3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS
- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
 - B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
 - C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - E. Provide servicing and lubrication schedule, and list of lubricants required.
 - F. Include manufacturer's printed operation and maintenance instructions.
 - G. Include sequence of operation by controls manufacturer.
 - H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

- I. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- J. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- K. Include test and balancing reports.
- L. Additional Requirements: As specified in individual product specification Sections.

3.5 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into electronic files for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification Sections.
 - 1. Where systems involve more than one specification Section, provide separate electronic bookmarked tab for each system.
- B. Electronic Cover Page: Identify each file with first page titled OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- C. Table of Contents: Arrange content by systems under Section numbers and sequence of Table of Contents of this Project Manual.
- D. Project Directory: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- E. Electronic Bookmarking: Provide electronically bookmarked divider pages in each file for each separate product and system; identify the contents on the divider page; immediately following the divider page include a description of product and major component parts of equipment.
- F. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Electronic scans warranties and bonds.
 - 4. Design Data: To allow for addition of design data furnished by Architect or others, provide a bookmarked divider page labeled "Design Data" and allow for insertion of additional electronic data, if applicable.

3.6 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
 - 1. Warranties must clearly state that warranty commences on Date of Substantial Completion, and the actual Date of Substantial Completion according to the Contract must be clearly stated on the warranty form.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.
- F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification Section in which specified, and the name of product or work item.

END OF SECTION

CLOSEOUT SUBMITTALS

01 78 00 - 3

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification Sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. HVAC systems and equipment.
 - 2. Plumbing equipment.
 - 3. Electrical systems and equipment.
 - 4. Landscape irrigation.
 - 5. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Finishes, including flooring, wall finishes, ceiling finishes.
 - 2. Fixtures and fittings.
 - 3. Items specified in individual product Sections.

1.2 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
 - 1. Format: DVD Disc or accepted alternative media.
 - 2. Label each disc and container with session identification and date.

1.3 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this Section, unless approved in advance by Owner.
- B. Demonstration may be combined with Owner personnel training if applicable.
- C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.2 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.

11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section Includes:
 - 1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
- 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: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

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

1.4 COORDINATION

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

1.5 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Survey of Existing Conditions: Submit survey.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust 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 on-site operations are uninterrupted.
 - 2. Temporary 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.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

1.8 FIELD CONDITIONS

- A. Owner will not 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:
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

- D. Hazardous Materials:
 - 1. It is not expected that hazardous materials will be encountered in the Work.
 - a. Hazardous materials will be removed by Owner before start of the Work.
 - b. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site sale of removed items or materials is not permitted.

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.

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. 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. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video. Comply with Division 01 Requirements.
 - 1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
 - 2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

- A. 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.
- B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

- A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
 - 3. Demolish and remove existing building 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. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.
 - 4. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:
 - a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
 - b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.

3.4 SALVAGE/REINSTALL

- A. Removed and Salvaged Items:
 - 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.
- B. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. 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.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to 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 12 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.
- 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.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS
- A. Concrete:
1. 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.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive in accordance with recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight..
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.
- 3.7 DISPOSAL OF DEMOLISHED MATERIALS
- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- 3.8 CLEANING
- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.
- 1.2 ACTION SUBMITTALS
 - A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Form ties.
 - 4. Form-release agent.
 - B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Field quality-control reports.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
- 2.2 FORM-FACING MATERIALS
 - A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.
- 2.3 RELATED MATERIALS
 - A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
 - B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
 - C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes
- C. Limit concrete surface irregularities as follows:
 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 1. Minimize joints.
 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 1. Provide and secure units to support screed strips.
 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. Clean embedded items immediately prior to concrete placement.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.
- 1.2 ACTION SUBMITTALS
 - A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
 - B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
 - C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of Architect.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Field quality-control reports.

PART 2 - PRODUCTS

- 2.1 STEEL REINFORCEMENT
 - A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
 - B. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
 - C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- 2.2 REINFORCEMENT ACCESSORIES
 - A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
- 2.3 FABRICATING REINFORCEMENT
 - A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

- 3.1 PREPARATION
 - A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
 - B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- 3.2 INSTALLATION OF STEEL REINFORCEMENT
 - A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
 - B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

- 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 - 2. Stagger splices in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 6 inches for plain wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.
- 3.3 JOINTS
 - A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
- 3.4 INSTALLATION TOLERANCES
 - A. Comply with ACI 117.
- 3.5 FIELD QUALITY CONTROL
 - A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Inspections:
 - 1. Steel-reinforcement placement.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Admixtures.
4. Vapor retarders.
5. Floor and slab treatments.
6. Liquid floor treatments.
7. Curing materials.
8. Accessories.
9. Repair materials.
10. Concrete mixture materials.
11. Concrete mixture class types.
12. Concrete mixing.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 035300 "Concrete Topping" for concrete floor toppings.
4. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
5. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.2 ACTION SUBMITTALS

A. Product data.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Compressive strength at 28 days or other age as specified.
3. Durability exposure classes for Exposure Categories F, S, W, and C.
4. Maximum w/cm ratio.
5. Slump or slump flow limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Intended placement method.
9. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Preconstruction test reports.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.
 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.
- C. Field Quality-Control Testing Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE STANDARDS

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
1. Portland Cement: ASTM C150/C150M, Type I, II or III, gray.
 2. Pozzolans: ASTM C618, Class C, F, or N.
 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 4. Ground Glass Pozzolan: ASTM C1866/C1866M, Type GS or GE.
- B. Normal-Weight Aggregates:
1. Coarse Aggregate: ASTM C33/C33M, Class 1N
 2. Maximum Coarse-Aggregate Size: 1 inches nominal.
 3. Fine Aggregate: ASTM C33/C33M.
 4. Recycled Aggregate: Not Permitted..

2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M.
- B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Admixtures with special properties, with documentation of claimed performance enhancement, ASTM C494/C494M, Type S.
- C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602/C1602M.

2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class C: ASTM E1745, Class C; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
1. Color:
 - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
 - b. Ambient Temperature between 50 and 85 deg F (10 and 29 deg C): Any color.
 - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- D. Water: Potable water that does not cause staining of the surface.

2.6 ACCESSORIES

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types I and II, nonload bearing for bonding hardened or freshly mixed concrete to hardened concrete.
- 2.7 REPAIR MATERIALS
 - A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
- 2.8 CONCRETE MIXTURE MATERIALS
 - A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
 - B. Cementitious Materials: Either fly ash or ground granulated blast furnace slag (GGBFS) may be used for the SCM but shall not be used together to form a ternary mix. Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:
 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 25 percent by mass.
 - C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
- 2.9 CONCRETE MIXTURE CLASS TYPES
 - A. Class A: Normal-weight concrete used for footings.
 1. Exposure Class: ACI 318 Class F0.
 2. Minimum Compressive Strength: 3000 psi at 28 days.
 3. Maximum w/cm Ratio: 0.50.
 4. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cementitious materials.
 - B. Class B: Normal-weight concrete used for interior slabs-on-ground and foundation walls.
 1. Exposure Class: ACI 318 Class F0.
 2. Minimum Compressive Strength: 3000 psi at 28 days.
 3. Maximum w/cm Ratio : 0.55
 4. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 5. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- 2.10 CONCRETE MIXING
 - A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
 - B. Do not proceed until unsatisfactory conditions have been corrected.
- 3.2 TOLERANCES
 - A. Comply with ACI 117..
- 3.3 INSTALLATION OF EMBEDDED ITEMS
 - A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
- 3.4 INSTALLATION OF VAPOR RETARDERS
 - A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

3.5 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

3.6 INSTALLATION OF JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Space vertical joints in walls as indicated on Drawings.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3/16-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.7 APPLICATION OF FINISHING FLOORS AND SLABS

- A. Trowel Finish:
 - 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 - 2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
 - 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 4. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.
 - 5. Do not apply troweled finish to concrete, which has a total air content greater than 3 percent.
 - 6. Finish surfaces to the following tolerances, in accordance with **ASTM E1155 (ASTM E1155M)**, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
- B. Trowel and Fine-Broom Finish: First apply a trowel finish to surfaces **[indicated on Drawings] [where ceramic or quarry tile is to be installed by either thickset or thinset method]**. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 - 1. Coordinate required final finish with Architect before application.
 - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.

2. Coordinate required final finish with Architect before application.

3.8 APPLICATION OF FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117. Class D.
 - e. Apply to concrete surfaces for metal lap pan deck formed surfaces and those surfaces that are buried or covered with subsequent installed surfaces.

B. Rubbed Finish: Apply the following to as-cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on Drawings.

3.9 APPLICATION OF CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing after finishing concrete.
2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 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.

- a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:
 - a) Water.
 - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 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.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

3.10 INSTALLATION OF JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

3.11 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and match surrounding surface.
 - 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.
- D. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
 3. After concrete has cured at least 14 days, correct high areas by grinding.
 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
 - E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
 - F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.12 FIELD QUALITY CONTROL
- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
 - B. Delivery Tickets: Comply with ASTM C94/C94M.
 - C. Inspections:
 1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
 - D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. Yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests as needed.
 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.

- a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.
 5. Concrete Density: ASTM C138/C138M:
 - a. One test for each composite sample when strength test specimens are cast.
 6. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and standard cure two sets of four 6 inches by 12-inches or 4-inch by 8-inch cylindrical specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 days.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.
 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- 3.13 PROTECTION
- A. Protect concrete surfaces.
 - B. Protect from petroleum stains.
 - C. Prohibit vehicles from interior concrete slabs.
 - D. Prohibit placement of steel items on concrete surfaces.

END OF SECTION

SECTION 03 54 00 - CAST UNDERLAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Liquid-applied self-leveling floor underlayment.

1.2 REFERENCE STANDARDS

- A. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- C. ASTM E1007 - Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures; 2021.
- D. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, mixing instructions, environmental limitations, storage and handling requirements, installation instructions, and compliance with specified regulatory requirements including substantiating test data for fire rated assemblies and sound rating.
- C. Certificate: Certify that products and systems meet or exceed specified regulatory requirements.
- D. Manufacturer's Instructions.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this Section, and approved by manufacturer.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for combustibility or flame spread requirements.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of underlayment materials in the required fire rated assembly.
- C. Conform to basis of design UL Assembly Design specified on Drawings.
- D. Sound Rating: Meet or exceed STC 50 and IIC 50 in wood truss floor assembly, in accordance with ASTM E90 and ASTM E413.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F (41 degrees C).

1.7 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F (10 degrees C) 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Gypsum Underlayment:
 - 1. Maxxon Corporation; Product Gyp-Crete 2000: www.maxxon.com (Basis of Design).
 - 2. USG; Levelrock: www.usg.com.
 - 3. Henry Co., Henry 555 Level Pro: www.wwhenry.com
 - 4. Hacker Industries, Inc.; Firm-Fill Gypsum Concrete: www.hackerindustries.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Gypsum-Based Underlayment: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 - 1. Compressive Strength: Minimum 2500 psi (17.24 MPa), or as required to comply with basis of design tested assembly requirements; tested according to ASTM C472.
 - 2. Density: Maximum 115 lb/cu ft (1842 kg/cu m), or as required to comply with basis of design tested assembly requirements.
 - 3. Final Set Time: 1 to 2 hours, maximum.
 - 4. Thickness: Refer to Drawings.
 - 5. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- B. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
- C. Primer: Manufacturer's recommended type.
- D. Sound Control Mat: Resilient sheet material, perimeter isolation strip, and tape system; cast underlayment manufacturer's proprietary or recommended product specifically designed for sound control as part of a composite underlayment system; 5/32 inch minimum thickness.
 - 1. Comply with specified tested assembly requirements for floor/ceiling assembly to achieve minimum specified sound transmission and impact ratings.
 - 2. Acceptable Product: Acoustimat LPR.
- E. Sealer: Manufacturer's proprietary overspray material, formulated to seal cured floor surfaces to receive subsequent adhered finishes.

2.3 MIXING

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

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.2 PREPARATION

- A. Wood: Install metal lath for reinforcement of underlayment.
- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.
- D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- E. Close floor openings.
- F. Install sound control mat where tile and other hard-surface floor finishes are indicated, in accordance with manufacturer's instructions.

1. Discontinue mat at intersections with demising walls and similar locations where indicated. Provide continuous perimeter isolation at those intersection locations using same material as specified sound reduction mat. Install perimeter isolation according to sound reduction mat manufacturer's recommendations.
2. Transition from locations where sound reduction mat is installed to primary floor surface elevation; use transition strip or other recommended means to create straight and uniform transitions between carpet and resilient flooring areas where such condition is indicated on Drawings. Coordinate finished underlayment surface elevations with flooring thicknesses, door openings, and required clearances.

3.3 APPLICATION

- A. Install cast underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not retemper or add water.
 1. Pump, move, and screed while the material is still highly flowable.
 2. Be careful not to create cold joints.
 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).
- D. Place after partition installation.

3.4 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.
- C. Apply sealer to cured flooring surfaces scheduled to receive adhered and glued-down finishes.
- D. Seal damaged floor surfaces, regardless of scheduled finish, in accordance with manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field inspection and testing, as specified in Section 01 40 00 - Quality Requirements.
- B. Provide access to accommodate tests and inspections by independent testing agency employed by Owner.
- C. Placed Material: Agency will inspect and test for conformance to specified requirements. Perform the following not less than once each day during placement of underlayment.
 1. Mold and test one set of 3 test cubes of gypsum concrete in accordance with ASTM C472, and other procedures as recommended by manufacturer. Furnish report on dry density and compressive strength to Architect and Owner upon request.
 2. Perform one slump test with a 2 inch diameter x 4 inch tall cylinder. Acceptable range of patty after cylinder is removed is 8 inch diameter (+/- 1 inch).
- D. Provide for testing of representative acoustical floor assemblies or mock-ups for compliance with specified performance requirements in accordance with ASTM E1007.
 1. Test one representative floor/ceiling assembly of each type and assembly characteristics.
- E. Nonconforming Work: Correct defective work to achieve compliance with specified acoustical performance requirements, at no additional cost to Owner.

3.6 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete block where indicated on the Drawings for:
- B. Clay facing brick veneer.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Lintels.
- G. Accessories.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2024b.
- C. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2023.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- E. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- F. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- G. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.
- H. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.
- I. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.
- J. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- K. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2023.
- L. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023a.
- M. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- N. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- O. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- P. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.
- Q. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- R. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.
- S. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- T. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- U. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.
- V. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023b.
- W. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.
- X. BIA Technical Notes No. 18A - Accommodating Expansion of Brickwork; 2019.
- Y. BIA Technical Notes No. 20 - Cleaning Brickwork; June 2006.
- Z. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
- AA. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
- BB. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Direct and coordinate placement of metal anchors supplied for installation under other Sections.

- B. Preinstallation Meeting: Convene meeting one week before starting work of this Section.
 - 1. Convene under general provisions of Section 01 70 00.
 - 2. Require attendance by all relevant installers.
 - 3. Require attendance of parties directly affecting work of this Section.
 - 4. Review conditions of installation, installation procedures, and coordination with related work.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
 - 1. Include product data for integral water repellent admixture, indicating compliance with specified performance requirements.
- C. Samples: Submit four samples of facing brick and decorative block units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

1.5 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. 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.
- D. Mortar Materials: Obtain mortar ingredients of a uniform quality, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- E. Cold-Weather Requirements:
 - 1. Protect masonry units from freezing weather and prevent accumulation of ice.
 - 2. Do not build on frozen substrates.
 - 3. Remove and replace unit masonry damaged by frost or by freezing conditions.
 - 4. Do not lay concrete masonry units when temperature of surrounding atmosphere is below 40 degrees F or is likely to fall below 40 degrees F in the 24 hour period after laying, unless adequate protection is provided.
 - 5. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

1.6 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Mock-up: Construct a masonry wall as a mock-up panel sized 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), wall insulation, and full weather barrier system in mock-up.
 - 1. Locate as indicated on Drawings.
 - 2. Mock-up may remain as part of work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry and cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- D. Replace damaged material at no cost to Owner.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMU)

- A. Acceptable Manufacturers:
 - 1. Valley Block Company: www.valleyblock.com.
 - 2. Basalite: www.basalite.com.
 - 3. Manufacturers for each product as specified in this Section.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. General: Comply with recycled content and recyclable materials product requirements specified in Section 01 60 00 - Product Requirements.
- C. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 4 inches for veneer and 8 inches (minimum) for fire walls .
 - 2. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block.
 - b. Medium weight.
 - c. Unit Compressive Strength: 2,150 psi, average net area, minimum.
 - d. Exposed Faces: Manufacturer's standard gray color and texture.
 - 3. Nonloadbearing Veneer Units: ASTM C129.
 - a. Hollow block, as indicated.
 - b. Lightweight.
 - c. Exposed Faces: Manufacturer's standard color and texture except where decorative faced units are indicated..
 - d. Decorative Faced Unit Patterns: Split faced, ground faced, or burnished faced as indicated on Drawings.
 - 4. Units with Integral Water Repellent: Concrete block units as specified in this Section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
 - a. Performance of Units with Integral Water Repellent:
 - 1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
 - (a) No water visible on back of wall above flashing at the end of 24 hours.
 - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.
 - 2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - 3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - b. Use only in combination with mortar that also has integral water repellent admixture.
 - c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.
 - d. Use water repellent admixture for all cmu exposed to the elements.
 - e. Acceptable Manufacturers:
 - 1) ACM Chemistries; www.acmchem.com.
 - 2) BASF Construction Chemicals; www.construction-chemicals.basf.com.
 - 3) Grace Construction Products; www.na.graceconstruction.com.

2.2 BRICK UNITS

- A. Acceptable Manufacturers:
 - 1. Belden Brick: www.beldenbrick.com/#sle.
 - 2. Endicott Clay Products Co.: www.endicott.com/#sle.
 - 3. General Shale Brick: www.generalshale.com.
 - 4. Meridian Brick LLC: www.meridianbrick.com/#sle.
 - 5. Robinson Brick Company: www.robinsonbrick.com.
 - 6. Summit Brick & Tile Co.: www.summitbrick.com.
 - 7. Substitutions: See section 01 60 00 - Product Requirements.
- B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.

1. Non-efflorescing when tested in accordance with ASTM C67/C67M.
2. Color and texture to match Architect's sample.
3. Actual Size: As indicated on Drawings.
4. Special Shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
 - a. Provide matching solid units for use at ends of soldier and sill courses.

2.3 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.
 1. Colored Mortar: Premixed cement as required to match Architect's color sample.
- B. Portland Cement: ASTM C150/C150M, Type I.
 1. Not more than 0.60 percent alkali.
 2. Hydrated Lime: ASTM C207, Type S.
 3. Mortar Aggregate: ASTM C144.
 4. Grout Aggregate: ASTM C404.
- C. Water: Clean and potable.
- D. Admixtures: Not permitted unless specified, or requested by Contractor in writing and approved in writing by Architect.
- E. Air-Entraining Admixture: Limit entrained air to maximum 12 percent.
- F. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 1. Performance of Mortar and Grout with Integral Water Repellent:
 - a. Water Permeance: When tested per ASTM E514/E514M for a minimum of 72 hours.
 - 1) No water visible on back of wall above flashing at the end of 24 hours.
 - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.
 - 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - b. Flexural Bond Strength: ASTM C1357; minimum 10 percent increase.
 - c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
 2. Use only in combination with masonry units manufactured with integral water repellent admixture.
 3. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 4. Meet or exceed performance specified for water repellent admixture used in masonry units.
 5. Acceptable Manufacturers:
 - a. ACM Chemistries; www.acmchem.com.
 - b. BASF Construction Chemicals; www.construction-chemicals.basf.com.
 - c. Grace Construction Products; www.na.graceconstruction.com.

2.4 REINFORCEMENT AND ANCHORAGE

- A. Acceptable Manufacturers:
 1. Blok-Lok Limited: www.blok-lok.com.
 2. Hohmann & Barnard, Inc.: www.h-b.com.
 3. WIRE-BOND www.wirebond.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Reinforcing Steel: Type specified in Section 03 20 00; size as indicated on Drawings; galvanized finish.
- C. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed billet bars; galvanized.
- D. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- E. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 1. Type: Truss.
 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.

3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
- F. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 1. Type: Truss.
 2. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
- G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.
- H. Masonry Veneer Anchors (where required by code and anywhere metal framing backup is present): 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A153/A153M Class B.
 1. Anchor Plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 2. Wire Ties: Triangular shape, 0.1875 inch (4.75 mm) thick.
 3. Vertical Adjustment: Not less than 3-1/2 inches (89 mm).
 4. Acceptable Product:
 - a. Wire-Bond; #1004X Type III X Screw On Veneer Anchor: www.wirebond.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Masonry Veneer Anchors (where allowed by code over wood framing):
 1. Model No. AA311, 7/8" wide x 7" long minimum (masonry ledge depth plus 4"), corrugated sheet steel, 20 gage, galvanized finish, as made by AA Wire Products or comparable product by Dur-O-Wall Inc., or Heckman
- J. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.
 1. Acceptable Product:
 - a. ITW Commercial Construction North America; Teks Select Series: www.ITWBuildex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.5 FLASHINGS

- A. Stainless Steel Flashing - Self-adhering: ASTM A240/A240M; 2 mil (0.05 mm) type 304 stainless steel sheet with 8 mil (0.20 mm) of butyl adhesive and a removable release liner.
 1. Acceptable Manufacturers:
 - a. VaproShield, LLC: www.vaproshield.com/#sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. York Manufacturing, Inc.; York 304SA: www.yorkmfg.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Termination Bars: Stainless steel; compatible with membrane and adhesives.
 1. Acceptable Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - b. Mortar Net Solutions; Termination Bars: www.mortarnet.com/#sle.
 - c. York Flashings; Termination Bar: www.yorkflashings.com/#sle.
- C. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.6 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 1. Acceptable Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com/#sle.
 - b. Hohmann & Barnard, Inc.: www.h-b.com/sle.
 - c. WIRE-BOND: www.wirebond.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - 2. Acceptable Manufacturer:
 - a. Advanced Building Products, Inc.; Mortar Break DT: www.advancedbuildingproducts.com/#sle.
 - b. Advanced Building Products Inc.; Mortar Break: www.advancedflashing.com/#sle.
 - c. Mortar Net Solutions; MortarNet: www.mortarnet.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Weeps: Molded PVC grilles, insect resistant.
 - 1. Width: Match specified mortar joint thickness; 3/8 inch, unless otherwise indicated.
 - 2. Height: Match height of applicable masonry unit, plus 3/8 inch.
 - 3. Depth: Match depth of applicable masonry unit, plus 1/4 inch.
 - 4. Color(s): As selected by Architect from manufacturer's full range.
 - 5. Acceptable Manufacturers:
 - a. Advanced Building Products, Inc.: www.advancedbuildingproducts.com/#sle.
 - b. Blok-Lok Limited: www.blok-lok.com/#sle.
 - c. CavClear, a Division of Archovations Inc.: www.cavclear.com/#sle.
 - d. Hohmann & Barnard, Inc.: www.h-b.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
 - 1. Acceptable Product:
 - a. ProSoCo, Inc.; Safety Clean: www.prosoco.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.7 LINTELS

- A. Steel Lintels: Specified in Section 05 50 00.
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

2.8 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
 - 1. Masonry Below Grade in Contact With Earth: Type S.
 - 2. Exterior Loadbearing Masonry: Type S.
 - 3. Exterior Non-loadbearing Masonry: Type N.
 - 4. Interior Loadbearing Masonry: Type N.
 - 5. Interior Non-loadbearing Masonry: Type O.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).
- D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other Sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Verify that weather barrier is installed according to Section 07 25 13.

3.2 PREPARATION

- A. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.
- B. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.
- C. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.
- D. Brick Units:
 - 1. Bond: As indicated for different locations.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at maximum 24 inches (600 mm) on center horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and rowlock/belt courses where indicated, unless otherwise specified.
 - 1. Space weeps maximum 16 inches on center where through-wall flashings are installed directly below rowlock courses, belt courses, precast concrete courses, and similar locations.
- B. Install cavity vents in veneer and cavity walls at maximum 32 inches (800 mm) on center horizontally below shelf angles and lintels and near top of walls.
- C. Position weep/cavity vent tabs to extend maximum 1/8 inch (3 mm) beyond outside face of veneer masonry, but not less than 1/16 inch (1.5 mm).

3.7 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install drainage fabric or cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.8 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on Drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.
- E. Lap joint reinforcement ends minimum 12 inches (300 mm).
- F. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches (400 mm) on center.
- G. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on Drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 24 inches (600 mm) horizontally and 16 inches (400 mm) vertically.
- H. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches (38 mm) with at least 5/8 inch (16 mm) mortar cover to the outside face of the anchor.

3.9 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors in masonry back-up to bond veneer at maximum 1.77 sq ft (0.16 sq m) of wall surface per anchor. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 1.77 sq ft (0.16 sq m) of wall surface per anchor. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

3.10 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

- A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on Drawings.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.

3.11 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up at least 8 inches (203 mm), minimum, to form watertight pan at non-masonry construction. Use continuous lengths of flashing material in each individual opening wherever possible; minimize seams.
 - 2. Form end dams at sides of flashing openings as recommended by flashing manufacturer for indicated conditions of installation and service.
 - 3. Seal top edge of flashings with manufacturer's required termination bar and continuous sealant bead at top edge of termination bar.
 - 4. Install 1 inch fillet bead of liquid membrane or mastic at changes in plane to fully support membrane at those locations.
 - 5. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 6. Tape seal butted seams and penetrations of flashing before covering with mortar.
 - 7. Terminate through wall flashing at flashing around windows, doors, and other penetrations for a water tight installation.
- B. Terminate flashing up 8 inches (203 mm) minimum on vertical surface of backing:
 - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
 - 2. Anchor vertical leg of flashing into backing with a termination bar and sealant.
 - 3. Apply cap bead of sealant on top edge of self-adhered flashing.

- C. Extend metal flashings with straight edge to within 1/8 inch (3 mm) of exterior face of masonry veneer; do not extend flashing edge beyond outside face of masonry veneer.
- D. Support flexible flashings across gaps and openings.
- E. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

3.12 LINTELS

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Reinforced Lintels: Place reinforcing as indicated on Drawings.
 - 2. Openings to 42 inches (1070 mm): Place two, No. 3 (M9) reinforcing bars 1 inch (25 mm) from bottom web.
 - 3. Openings from 42 inches (1070 mm) to 78 inches (1980 mm): Place two, No. 5 (M16) reinforcing bars 1 inch (25 mm) from bottom web.
 - 4. Openings over 78 inches (1980 mm): Reinforce openings as detailed.
 - 5. Do not splice reinforcing bars.
 - 6. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
 - 7. Place and consolidate grout fill without displacing reinforcing.
 - 8. Allow masonry lintels to attain specified strength before removing temporary supports.
- C. Maintain minimum 4 inch (100 mm) bearing on each side of opening for steel lintels, unless otherwise indicated on Drawings.

3.13 GROUTED COMPONENTS

- A. Reinforce bond beams as indicated on Drawings.
- B. Lap splices minimum 24 bar diameters.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. Grout solid all hollow concrete unit masonry located below grade, and at other locations indicated.
- F. At bearing locations, fill masonry cores with grout for a minimum 12 inches (300 mm) both sides of opening.

3.14 ENGINEERED MASONRY

- A. Lay masonry units with core cells vertically aligned clear of mortar and unobstructed.
- B. Place mortar in masonry unit bed joints back 1/4 inch from edge of unit grout spaces, bevel back and upward. Permit mortar to cure 7 days before placing grout.
- C. Reinforce masonry unit cores with reinforcement bars and grout.
- D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters. Splice reinforcement in accordance with Section 03200.
- E. Grout spaces less than 2 inches in width with fine grout using low lift grouting techniques. Grout spaces 2 inches or greater in width with course grout using high or low lift grouting techniques.
- F. When grouting is stopped for more than 1 hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.
- G. Low Lift Grouting: Place first lift of grout to a height of 16 inches and rod for grout consolidation. Place subsequent lifts in 8 inch increments and rod for grout consolidation.
- H. High Lift Grouting
 - 1. Provide cleanout opening no less than 4 inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit.
 - 2. In double wythe walls, omit every second masonry unit in one of the wythes for clean out and cell inspection purposes.
 - 3. In double wythe walls, construct vertical grout barriers or dams between the masonry wythes, with masonry units every 30 feet maximum.

4. Clean out masonry cells and cavities with high pressure water spray. Permit complete water drainage.
5. Request the Owner's Representative to inspect the cells. Allow 3 days advance notice of inspection.
6. After cleaning and cell inspection, seal openings with masonry units.
7. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
8. Limit grout lift to 48 inches and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.15 CONTROL AND EXPANSION JOINTS

- A. General: Comply with general requirements of BIA Technical Notes No. 18A.
- B. Size and locate control joints as indicated on Drawings; if not shown, 3/8 inch (9 mm) wide; verify all joint locations with Architect.
 1. Spacing - General: Maximum 25 feet, except as otherwise indicated on Drawings for closer spacing or other conditions as specified below.
 - a. Provide sealed expansion joint at all internal corners of only non-structural masonry veneer, whether or not specifically noted or detailed.
 - b. Provide sealed expansion joint within 15 feet of external corners of only non-structural masonry veneer.
- C. Do not continue horizontal joint reinforcement through control or expansion joints.
- D. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- E. Locate expansion joints as indicated on Drawings.

3.16 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other Sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.17 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch (6 mm).
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/8 inch, plus 1/8 inch (minus 3 mm, plus 3 mm).

3.18 CUTTING AND FITTING

- A. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.19 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Clay Masonry Unit Tests: Test each variety of clay masonry in accordance with ASTM C67/C67M requirements, sampling 5 randomly chosen units for each 50,000 installed.
- C. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
- D. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.20 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with specified cleaning solution, at low pressure or by hand methods only; do not introduce excessive moisture into masonry wall surfaces during cleaning operations.
- D. Use non-metallic tools and stiff brushes in cleaning operations.

3.21 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
 - 1. Install required protection of installed work at the end of each work day.

END OF SECTION

SECTION 04 26 13

MASONRY VENEER

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Brick.
 - 2. Concrete masonry units.
 - 3. Mortar materials.
 - 4. Ties and anchors.
 - 5. Embedded flashing.
 - 6. Accessories.
 - 7. Mortar mixes.
- 1.2 ACTION SUBMITTALS
 - A. Product Data: For each type of product.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Material Certificates: For each type and size of product.
- 1.4 MOCKUPS
 - A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build sample panels for **typical exterior wall** in sizes approximately **48 inches (1219 mm) long x full height of masonry wainscot**.
- 1.5 FIELD 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. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
 - B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

- 2.1 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.
- 2.2 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.
 - 3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
 - 4. Size (Actual Dimensions): King Sized **2-5/8 inches (70 mm)** tall x **9-5/8 inches (244 mm)** long x **2-3/4 inches (70 mm)** thick
 - 5. Color and Texture: To match existing Women's Dorm located to the southeast
- 2.3 CONCRETE MASONRY UNITS
 - A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Pattern and Texture: Standard pattern, ground-face finish.
- 2.4 MORTAR MATERIALS
- A. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime or masonry cement, sand and complying with ASTM C1714/C1714M.
 - B. Aggregate for Mortar: ASTM C144.
 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
 - C. Water: Potable.
- 2.5 TIES AND ANCHORS
- A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch 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. Stainless Steel Wire: ASTM A580/A580M, Type 304.
 3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 - C. Adjustable Masonry-Veneer Anchors:
 1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
 2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0785-inch thick steel sheet, galvanized after fabrication.
 3. Fabricate wire ties from 0.187-inch diameter, hot-dip galvanized steel wire unless otherwise indicated.
 4. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie.
 5. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie.
 6. Masonry-Veneer Anchors; Slotted Plate: Sheet metal anchor section, with screw holes at top and bottom; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie.
- 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] [Type 316], 0.016 inch (0.40 mm) thick.
 2. Fabricate continuous flashings in sections 96 inches (2438 mm) long minimum, but not exceeding
 3. 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].
 4. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6.4 mm) to form a stop for retaining sealant backer rod.
 - 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] [Type 316] stainless steel sheet, bonded to a layer of polymeric fabric, to produce an overall thickness of 40 mil (1.0 mm).
 2. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil (0.05 mm) of [Type 304] [Type 316] stainless steel sheet, bonded to a layer of polymeric fabric with a [butyl adhesive] [permanent, clear adhesive], to produce an overall thickness of [10 mil (0.25 mm)] [40 mil (1.0 mm)].
 - a. Applications: Use 10-mil- (0.25-mm-) thick flashing at windows, doors, and small wall penetrations; not at base of walls.[Use 40-mil- (1.0-mm-) thick flashing at base of walls.]

- C. Drainage Plane Flashing: Fabricate from **stainless steel** and drainage membrane to shapes indicated[, **including weep tabs, termination bar and drip edge**]. Provide flashing materials as follows:
 - 1. Stainless Steel: ASTM A240/A240M or ASTM A666, [**Type 304**] [**Type 316**], **0.016 inch (0.40 mm)** thick.
 - 2. Fabricate continuous flashings in sections **60 inches (1524 mm)** long, minimum.
 - D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 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 [**0.075 inch by 1 inch (1.9 mm by 25 mm)**] [**1/8 inch by 1 inch (3.2 mm by 25 mm)**] [**1/8 inch by 1-1/8 inch (3.2 mm by 29 mm)**].
 - G. Termination Bars for Flexible Flashing, Flanged: [**Stainless steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm)**] with a **3/8-inch (10-mm)** flange at top [**and bottom**].
- 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**] [**urethane**] [**or**] [**PVC**].
 - B. Weep/Vent Products: Use[**one of**] the following unless otherwise indicated:
 - 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, 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.
 - C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Mortar Deflector: Strips, [**full depth of cavity**] [**3/4 inch (19 mm) thick**] [**1 inch (25 mm)**] [**1-1/2 inches (38 mm) thick**] [**2 inches (51 mm)**] <Insert thickness> and [**10 inches (254 mm)**] [**16 inches (406 mm)**] <Insert thickness> high, with [**dovetail-shaped notches**] [**dimpled surface**] that prevent clogging with mortar droppings.
 - 2. Rainscreen Drainage Mat: Sheets or strips not less than [**full depth of cavity**] [**3/4 inch (19 mm)**] [**1 inch (25 mm)**] [**1-1/2 inches (38 mm) thick**] [**2 inches (51 mm)**] <Insert thickness> thick and installed to full height of cavity, [**with additional strips 4 inches (102 mm) high at weep holes and**
 - D. Offset Angle Supports: Steel plate brackets anchored to structure, allowing continuous insulation behind shelf angle supporting veneer. Component and anchor size and spacing engineered by manufacturer.
 - E. 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.
 - 1.
- 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 masonry 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 S unless another type is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. 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.

- B. 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.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. 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.

3.2 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.
- 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 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).**]

3.3 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.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.4 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing 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 **25 inches (635 mm)** o.c. horizontally, with not less than one anchor for each [**2.67 sq. ft. (0.25 sq. m)**] [**3.5 sq. ft. (0.33 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 **2 inches** of airspace between back of masonry veneer and face of [**sheathing**] [**insulation**].

3.5 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. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least **8 inches (203 mm)**; with upper edge tucked under **[water-resistive barrier] [air barrier]**, lapping at least **4 inches (102 mm)**.
 2. 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.
 - C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
 1. Use **[specified weep/cavity vent products] [or] [open-head joints]** to form weep holes.
 2. Space weep holes **24 inches (610 mm)** o.c. unless otherwise indicated.
 - D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.
- 3.6 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. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.
 - C. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.
 - D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- 3.7 CLEANING
- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
 - B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 1. 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.
 2. 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.
 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
- 3.8 MASONRY WASTE DISPOSAL
- A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated steel items, including:
 - 1. Bollards.
 - 2. Loose lintels.
 - 3. Door frames for overhead door openings.
 - 4. Bracing at head of storefront assemblies.
 - 5. Dumpster gate assemblies.
 - 6. Sunshade canopy assemblies.
 - 7. Other items as specified in this Section and as indicated on Drawings.

1.2 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- C. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- D. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- E. ASTM C230/C230M - Flow Table for Use in Tests of Hydraulic Cement; 2008.
- F. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- H. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
- I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- J. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC-Paint 15; fabricator's standard.

2.2 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

1. Comply with NOMMA voluntary guidelines for joint finishes; Finish #2 - completely sanded joint, some undercutting and pinholes acceptable.
- E. Provide for thermal expansion/contraction of exterior metal railings and similar linear fabrications exceeding 30 feet in running length; and not closer than 24 inches from corners and intersections.
- F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- G. Tubular and Hollow Fabrications: Fabricate with open ends or 1/8 inch diameter drilled holes for moisture weepage, unobtrusively located and concealed from view wherever possible.
- H. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

- A. Provide and install items shown on Drawings with anchorage and attachments necessary for installation.
- B. The following is a list of principal items only. Refer to Drawing details for items not specifically scheduled:
 1. Masonry shelf angles; prime paint finish.
 2. Bollards: Nominal 6 inch diameter, standard steel pipe, minimum wall thickness 0.280 inches; concrete filled, crowned cap, as detailed; finish as specified.
 - a. Interior and Exterior Bollards in Slab on Grade: Penetration depth below top of slab to equal detailed height; core hole in slab on grade 2 inches larger than bollard diameter, and fill joint at slab with a non-shrink grout; prime paint finish.
 3. Lintels: As detailed; prime paint finish. Supply to applicable unit masonry Section for installation.
 4. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.
 5. Dumpster Gate Assemblies: As detailed; prime paint finish.
 6. Sunshade Canopy Assemblies: As detailed; powder coat finish.

2.4 ACCESSORIES

- A. Non-Shrink Grout: ASTM C1107/C1107M, Grade B; pre-mixed compound consisting of non-metallic aggregate, cement, and manufacturer's specified water reducing and plasticizing agents; non-staining, non-gas-forming, containing no chlorides; plastic consistency as measured according to ASTM C230/C230M; capable of developing minimum compressive strength of 10,000 psi in 28 days.

2.5 FINISHES - STEEL

- A. General:
 1. Prepare surfaces to be primed in accordance with SSPC-SP 2, or as recommended by finish coating manufacturer.
 2. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Prime paint all steel items, unless otherwise specified.
 1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
 2. Prime Painting: One coat.

2.6 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.

- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Shear wall panels.
 - 4. Rooftop equipment bases and support curbs.
 - 5. Wood blocking and nailers.
 - 6. Wood furring.
 - 7. Wood sleepers.
 - 8. Plywood backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of process and factory-fabricated product.
 - 2. For preservative-treated wood products.

1.3 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.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - 4. Shear panels.
 - 5. Power-driven fasteners.
 - 6. Post-installed anchors.
 - 7. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 - 1. Boards: 19 percent.
 - 2. Dimension Lumber: 19 percent unless otherwise indicated.
 - 3. Timber: 19 percent.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 PRESERVATIVE TREATMENT

- A. Preservative Treatment by Pressure Process: AWP A 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. 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 and similar concealed members in contact with masonry or concrete.
 - 3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions by Grade: Construction, Stud or No. 2 grade.
 - 1. Application: Interior partitions not indicated as load bearing.
 - 2. Species:
 - a. Southern pine or mixed southern pine; SPIB.
- B. Framing Other Than Non-Load-Bearing Partitions by Grade: No. 2 grade.
 - 1. Application: Framing other than interior partitions not indicated as load bearing.
 - 2. Species:
 - a. Southern pine; SPIB.

2.4 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
 - 1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal depth members.
 - 2. Modulus of Elasticity, Edgewise: 1,900,000 psi.

2.5 SHEAR WALL PANELS

- A. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.

2.6 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.
 - 5. Furring.
 - 6. Grounds.
- B. Dimension Lumber Items: **Construction or No. 2** grade lumber of any species.
- C. Concealed Boards: **19** percent maximum moisture content and]the following species and grades:
 - 1. Mixed southern pine or southern pine; No. [2] [3] grade; SPIB.

2.7 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, **Exposure 1, C-D Plugged** in thickness indicated or, if not indicated, not less than [1/2-inch (13-mm)] nominal thickness.

2.8 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 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 with hot-dip zinc coating complying with ASTM A153/A153M.

- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
 - C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
- 2.9 METAL FRAMING ANCHORS
- A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
 - B. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- 2.10 MISCELLANEOUS MATERIALS
- A. Sill-Sealer Gaskets:
 - 1. Self-adhering sheet consisting of 64mils (1.6 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; **formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction**.
 - B. Adhesives for Gluing [Furring] [and] [Sleepers] to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
 - B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
 - C. 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.
 - D. Install shear wall panels to comply with manufacturer's written instructions.
 - E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
 - F. Do not splice structural members between supports unless otherwise indicated.
 - G. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
 - I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.
- 3.2 PROTECTION
- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
 - B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes **wet enough that moisture content exceeds that specified**, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 16 00

SHEATHING

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Wall sheathing.
 - 2. Roof sheathing.
 - 3. Sheathing joint and penetration treatment.
- 1.2 ACTION SUBMITTALS
 - A. Product Data: For each type of process and factory-fabricated product.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Evaluation Reports: For the following, from ICC-ES:

PART 2 - PRODUCTS

- 2.1 WALL SHEATHING
 - A. Plywood Sheathing, Walls: DOC PS 1, Exposure 1, Structural 1 sheathing.
 - B. Oriented-Strand-Board Sheathing, Walls: DOC PS 2, Exposure 1, Structural I sheathing.
- 2.2 ROOF SHEATHING
 - A. Plywood Sheathing, Roofs: DOC PS 1, Exposure 1, Structural 1 sheathing.
 - B. Oriented-Strand-Board Sheathing, Roofs: DOC PS 2, Exposure 1, Structural I sheathing.
- 2.3 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 and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

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 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.
- 3.2 WOOD STRUCTURAL PANEL INSTALLATION
 - 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. Subflooring:
 - a. Glue and nail to wood framing.
 - b. Space panels 1/8 inch apart at edges and ends.
 - 2. Wall and Roof Sheathing:
 - a. Nail to wood framing.

- b. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with nails or screws.
 - 2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
- B. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.

END OF SECTION

SECTION 06 16 43 - GYPSUM SHEATHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Parapet sheathing.
 - 3. Sheathing joint and penetration treatment.

1.2 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.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: 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.

1.4 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 according to ASTM E 119; 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 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc.
 - b. Continental Building Products, LLC; Weather Defense.
 - c. Georgia-Pacific Building Products; Dens-Glass Sheathing.
 - d. National Gypsum Company; Gold Bond eXP Sheathing.
 - e. United States Gypsum Company; Securock.
 - 2. Type and Thickness: Regular, 1/2 inch thick.
 - 3. Size: 48 by 120 inches for vertical installation.
 - 4. Mold Growth: 10 when tested according to ASTM D3273.
 - 5. Permeance: 22 perms.
 - 6. Combustibility: Noncombustible.

2.3 PARAPET SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; Glasroc.
 - b. Continental Building Products, LLC; Weather Defense.
 - c. Georgia-Pacific Building Products; Dens-Glass Sheathing.
 - d. National Gypsum Company; Gold Bond eXP Sheathing.

- e. United States Gypsum Company; Securock.
- 2. Type and Thickness: Regular, 1/2 inch thick.
- 3. Size: 48 by 120 inches for vertical installation.
- 4. Mold Growth: 10 when tested according to ASTM D3273.
- 5. Permeance: 22 perms.
- 6. Combustibility: Noncombustible.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. 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 thick, use screws that comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for- Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, 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 wide, 10 by 10 or 10 by 20 threads/inch, 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.

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 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
 - 3. ICC-ES evaluation report for fastener.
- D. Coordinate 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 GYPSUM SHEATHING INSTALLATION

- 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 gap where non-load-bearing construction abuts structural elements.
 - 3. Install panels with a 1/4-inch 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 o.c. and set back a minimum of 3/8 inch 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 o.c. and set back a minimum of 3/8 inch 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 according to 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.

END OF SECTION

SECTION 06 17 53

SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Wood roof trusses.
- 1.2 ALLOWANCES
 - A. Provide wood truss bracing under the Metal-Plate-Connected Truss Bracing Allowance as specified in Section 012100 "Allowances."
- 1.3 ACTION SUBMITTALS
 - A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
 - B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 6. Show splice details and bearing details.
 - C. Delegated-Design Submittals: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Metal-plate connectors.
 - 2. Metal truss accessories.
- 1.5 QUALITY ASSURANCE
 - A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Structural Performance: Metal-plate-connected wood trusses are to be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1.
 - B. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
 - C. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

- A. Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.

2.4 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 - 2. Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, are to comply with or exceed those of basis-of-design products. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

2.6 FABRICATION

- A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- F. Securely connect each truss ply required for forming built-up girder trusses.
- G. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
- H. Install wood trusses within installation tolerances in TPI 1.
- I. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- J. Replace wood trusses that are damaged or do not comply with requirements.

END OF SECTION

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior finish carpentry items, including:
 - 1. Wood base, casings, sills, and trim.
 - 2. Fixed closet and storage shelving.
 - 3. Other items as specified in this Section and as indicated on Drawings.

1.2 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- D. PS 1 - Structural Plywood; 2023.
- E. PS 20 - American Softwood Lumber Standard; 2025.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS).
- C. Samples: Submit two samples of each type of wood trim 12 inch (300 mm) long, illustrating profiles and completed finishes.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
 - 1. Store finish carpentry items in installation areas. If finish carpentry items must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.
 - 2. Stack lumber and provide for adequate air circulation within and around stacks and under temporary coverings.
 - 3. Protect from moisture damage.
- B. Handle materials and products to prevent damage to edges, ends, or surfaces.

1.5 ENVIRONMENTAL CONDITIONS

- A. Comply with specified standard and as additionally specified.
- B. Do not deliver finish carpentry items until environmental conditions meet specified requirements for installation areas.
- C. Do not deliver or install finish carpentry items until building is enclosed and weatherproof, wet work in installation areas is complete and nominally dry, and building's environmental control systems are operating and will maintain temperature and relative humidity at designed occupancy levels throughout the remainder of the construction period.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

- A. Quality Standard - General: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless otherwise specified for each carpentry item.
- B. Interior Woodwork Items:

1. Moldings, Bases, Casings, and Miscellaneous Trim: Medium density fiberboard; prepare for paint finish.
2. Window Sills: Finger jointed pine.
3. Closet Shelving: Medium density fiberboard; prepare for paint finish.

2.2 LUMBER MATERIALS

- A. Softwood Lumber for Interior Trim: PS 20; white pine species, plain or quarter sawn, maximum moisture content of 19 percent according to ASTM D4442; with flat grain, of quality suitable for opaque finishes.
 1. Grading: In accordance with rules certified by ALSC; www.alsc.org.
- B. Hardwood Lumber: Refer to ID finish schedule/legend for species, plain or quarter sawn, maximum moisture content of 6 percent according to ASTM D4442; with flat grain, of quality suitable for transparent finish.

2.3 SHEET MATERIALS

- A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Medium Density Fiberboard (MDF): ANSI A208.2; pressed hardwood fibers, made with waterproof resin binders, tempered grade; sanded faces.

2.4 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Fasteners: Of size and type to suit application; galvanized finish.
- C. Concealed Joint Fasteners: Threaded steel.

2.5 ACCESSORIES

- A. Lumber for Shimming and Blocking: Softwood lumber of fir or pine species.
- B. Closet Rods: Formed aluminum sheet with mounting plates on both ends; 1-1/4 inch diameter; lengths as indicated on Drawings.
 1. Mounting Brackets: Formed steel brackets designed to support wood shelf and continuous hanging rod; vertical leg with holes top and bottom for mall-mounting using lag screws into wall studs or solid blocking.
- C. Primer: Alkyd primer sealer.
- D. Wood Filler: Latex base, tinted to match surface finish color.

2.6 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this Section are placed and ready to receive this work.

3.2 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.
- D. Install components with finish nails at maximum 8 inch on center (nails at 200 mm on center).
- E. Install finish carpentry items with minimum number of joints practical, using full length pieces from maximum lengths of lumber available. Do not use individual pieces less than 24 inches long, except where necessary.

1. Stagger joints in adjacent and related standing and running trim.
 2. Cope at returns and miter at corners to produce tight-fitting joints with full surface contact throughout the length of joints.
 3. Plane back surfaces of casings as required to provide uniform thickness and flush finished surfaces across joints.
- F. Install trim after finishing of substrate surfaces is complete.
- G. Pre-drill pilot holes in hardwood carpentry items before fastening to prevent splitting. Securely fasten to prevent warping or movement.
- 3.3 PREPARATION FOR SITE FINISHING
- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 93 00 and 099000.
- 3.4 PROTECTION
- A. Protect installed finish carpentry items from damage due to subsequent construction operations.

END OF SECTION

SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet and casework units for common areas.
- B. Hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS

- A. Section 12 36 00 - Countertops.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- C. BHMA A156.9 - Cabinet Hardware; 2020.
- D. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Field verify critical dimensions and clearances prior to fabrication of casework items; assure that field conditions are as required to comply with indicated design requirements.
 - 2. Verify accurate field measurements in installation areas before wall cavities are enclosed; verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork; record measurements on shop drawings.
 - 3. Where field measurements cannot be made without delaying work, establish required dimensions and maintain those dimensions for fabrication of woodwork.
 - 4. Coordinate construction to ensure that actual dimensions correspond to established required dimensions.
 - 5. Coordinate cabinet spacing and clearances to ensure that doors and drawers do not conflict with each other.
 - 6. Coordinate cabinet opening and spacing requirements with approved appliances and plumbing fixtures.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide information as required by AWI/AWMAC/WI (AWS).
 - 3. Shop drawings are required to be generated as separate digital drawings specific to this Project, not utilizing Architect's digital drawing files in any manner; comply with other restrictions on use of Architect's digital drawing files specified in Section 01 3000.
 - 4. Show all adjacent construction including abutting walls, columns and similar elements affecting casework installation.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet face construction, minimum 12 inches (300 mm) square, illustrating proposed cabinet substrate and finish.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this Section with minimum five years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver casework items to installation areas only after clean, well ventilated, and temperature-controlled installation areas are available. Do not deliver casework items to installation areas until painting and similar operations are complete in those areas.
- B. Protect units from moisture and impact damage during transit, delivery, and storage; use protective covers during delivery, storage, and handling operations.

1.8 FIELD CONDITIONS

- A. Do not deliver or install casework items until building is enclosed and weatherproof, and building's environmental control systems are operating and will maintain temperature and relative humidity at designed occupancy levels throughout the remainder of the construction period.
- B. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 WOOD CASEWORK AND CABINETS

- A. Quality Standard - General: Grades as indicated or specified, in accordance with AWI/AWMAC/WI (AWS).
 - 1. Plastic Laminate Faced Cabinets:
 - a. Quality Standard: Custom Grade, unless noted otherwise.

2.2 PANEL CORE MATERIALS

- A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.
 - 1. Grade: M-2; moisture resistance: MR10.
 - 2. Panel Thickness: 3/4 inch (19.1 mm).

2.3 HARDWOOD PLYWOOD PANELS

- A. Hardwood Plywood: Plywood manufactured for nonstructural decorative applications; consisting of faces and backs applied to a variety of core types; comply with HPVA HP-1.
 - 1. Woodwork Quality Standard: Panels complying with specified woodwork quality standard.
 - 2. Face: Species as indicated on drawings; grade AA or as otherwise indicated on the Drawings.
 - a. Finish: Natural, unfinished.
 - 3. Back: Balancing backer.
 - 4. Core, Particleboard: Comply with ANSI A208.1.
 - a. Grade: M-2; moisture resistance: MR10.
 - b. Construction and Thickness: 3 plies, 3/4 inch (19.1 mm).

2.4 LAMINATE MATERIALS

- A. Acceptable Manufacturers:
 - 1. Arborite: www.arborite.com/#sle.
 - 2. Panolam Industries International, Inc.: www.panolam.com/#sle.
 - 3. Wilsonart LLC: www.wilsonart.com/#sle.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3; colors as indicated or specified on Drawings.
 - 1. Provide specific types as follows:
 - a. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness.
 - b. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness.
 - c. Cabinet Liner: CLS, 0.020 inch (0.51 mm) nominal thickness.
 - d. Laminate Backer: BKL, 0.020 inch (0.51 mm) nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.5 COUNTERTOPS

- A. Countertops: See Section 12 36 00.

2.6 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Wire and Cable Manager: Extruded plastic trough profile with attachment flanges; matte black color; configured for horizontal and vertical applications as indicated on Drawings.
 - 1. Acceptable Product:
 - a. Doug Mockett & Company, Inc.; WM2/WM22 J-Shape Wire Manager: www.mockett.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to blend with adjacent surface.

2.7 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified, unless otherwise specified in this Section.
- B. Should products and finishes indicated herein be contrary to ID Finish Schedule, the ID Finish Schedule shall govern.
- C. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- D. Drawer and Door Pulls: Unless otherwise indicated in Finish Schedule, provide "U" shaped wire pull, steel with satin finish, 4 inch centers ("U" shaped wire pull, steel with satin finish, 100 mm centers).
- E. Cabinet Catches and Latches:
 - 1. Type: Push latch.
- F. Drawer Slides:
 - 1. Type: Full extension with overtravel.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Finish: Selected from manufacturer's standard line.
 - 6. Features: Provide self-closing/stay-closed/soft-close type.
 - 7. Acceptable Manufacturers:
 - a. Accuride International, Inc.; Light-Duty Drawer Slides: www accuride.com/#sle.
 - b. Blum, Inc.; MOVENTO: www.blum.com/#sle.
 - c. Grass America Inc.; Ball Bearing Slide System: www.grassusa.com/#sle.
 - d. Knappe & Vogt Manufacturing Company; Light-Duty Drawer Slides: www.knapeandvogt.com/#sle.
- G. Hinges: European style concealed, self-closing type, steel with satin finish.
 - 1. Features: Provide self-closing/stay-closed/soft-close type.
 - 2. Acceptable Manufacturers:
 - a. Blum, Inc.; CLIP top BLUMOTION: www.blum.com/#sle.
 - b. Grass America Inc.; Institutional Hinges: www.grassusa.com/#sle.
- H. Door Bumpers: Drilled-in, clear, soft plastic.

2.8 FABRICATION

- A. Cabinet Style: Flush overlay or as otherwise detailed on the drawings.
- B. Minimum Component Thicknesses:
 - 1. Tops: As specified in Section 12 36 00.
 - 2. End and Back Panels: 3/4 inch (19 mm), recessed or flush; provide end and back panels on all cabinets.

- C. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
 - D. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
 - E. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
 - F. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Apply thermally fused laminate to inside of cabinets on exposed and semi-exposed surfaces, and to shelving surfaces.
 - G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- 2.9 SHOP FINISHING
- A. Sand work smooth and set exposed nails and screws.
 - B. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 12, Polyurethane, Water-based.
 - b. Sheen: Satin.

PART 3 EXECUTION

- 3.1 EXAMINATION
- A. Verify adequacy of backing and support framing.
 - B. Verify location and sizes of utility rough-in associated with work of this Section.
 - C. Verify critical clearances and dimensions prior to installation of casework items.
- 3.2 INSTALLATION
- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
 - B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
 - C. Use fixture attachments in concealed locations for wall mounted components.
 - D. Use concealed joint fasteners to align and secure adjoining cabinet units.
 - E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
 - F. Secure full height cabinets, shelving units, and similar casework items exceeding 60 inches in height to floor using appropriate angles and anchorages.
- 3.3 ADJUSTING
- A. Adjust moving or operating parts to function smoothly and correctly.
- 3.4 CLEANING
- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.
- 3.5 PROTECTION
- A. Protect installed casework items from damage due to subsequent construction operations.

END OF SECTION

SECTION 06 61 16 - SOLID SURFACING FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Solid surface fabrications including window sills.

1.2 ACTION SUBMITTALS

- A. Product Data: For solid surfacing materials.
- B. Shop Drawings: Show materials, finishes, and edge profiles and methods of joining.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 - 1. Solid surfacing material, 6 inches (150 mm) square.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material 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.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate solid surfacing similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of solid surfacings.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of solid surfacing fabrications by field measurements for coordination and installation with other materials.

PART 2 - PRODUCTS

2.1 SOLID SURFACE MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 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. Affinity Surfaces; a brand of Domain Industries, Inc.
 - b. Avonite Surfaces.
 - c. E. I. du Pont de Nemours and Company.
 - d. Formica Corporation.
 - e. LG Chemical, Ltd.
 - f. Meganite Inc.
 - g. Samsung Chemical USA, Inc.
 - h. Swan Corporation (The).
 - i. Transolid Div of Trumbull Industries.
 - j. Wilsonart.

2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As scheduled.

2.2 SOLID SURFACING FABRICATION

- A. Fabricate solid surfacings according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 1. Grade: Premium.
- B. Solid Surfacings: 1/2-inch- (12.7-mm-) thick, solid surface material.
- C. Fabricate with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- D. Joints: Fabricate solid surfacings without joints.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Solid surfacings: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material and conditions under which solid surfacings will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of solid surface.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install solid surfacings 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 solid surfacings by screwing through corner blocks of base units into underside of solid surfacing. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match solid surfacing, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION

SECTION 06 65 00 - DECORATIVE PVC TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. PVC Pediment.

1.2 ACTION SUBMITTALS

- A. Product Data: Including all pertinent performance characteristics and criteria.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's documentation.

PART 2 - PRODUCTS

2.1 PVC PEDIMENT

- A. Acceptable Product: Ekena Millwork; PEDPC084X280ACR00.
 - 1. Measurements:
 - a. Bottom Width: 84 inches.
 - b. Height: 27 and 7/8 inches.
 - c. Pitch: 2 and 3/4 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to receive work of this Section.
- B. Notify Architect of any existing conditions which will adversely affect execution.
- C. Beginning of execution will constitute acceptance of existing conditions.

3.2 PREPARATION

- A. Prepare substrate surfaces as recommended by manufacturer.

3.3 INSTALLATION

- A. Install using skilled workers in accordance with manufacturer's published instructions and recommendations.

3.4 ADJUSTING

- A. Adjust and fit items to be flush with adjacent construction.

END OF SECTION

SECTION 06 65 05 - FIBERGLASS REINFORCED POLYMER COLUMN COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fiberglass Reinforced Polymer Column Covers.

1.2 ACTION SUBMITTALS

- A. Product Data: Including all pertinent performance characteristics and criteria.
- B. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Instructions: For installation, maintenance, and repair.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

2.2 PRODUCTS

- A. Fiberglass Reinforced Polymer Column Covers.
 - 1. Basis-of-Design Product: Pacific Columns, Inc.; Endura-Stone
 - 2. Profile: Round.
 - a. Capital and Base: Tuscan.
 - 3. Integral Finish: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to receive work of this Section.
- B. Notify Architect of any existing conditions which will adversely affect execution.
- C. Beginning of execution will constitute acceptance of existing conditions.

3.2 PREPARATION

- A. Prepare substrate surfaces as recommended by manufacturer.

3.3 INSTALLATION

- A. Install using skilled workers in accordance with manufacturer's published instructions and recommendations.

3.4 ADJUSTING

- A. Adjust and fit items to be flush with adjacent construction.
- B. Fasten or adhere for tight connections and joints.

END OF SECTION

SECTION 06 83 16 - FIBERGLASS REINFORCED PLASTIC (FRP) PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Accessories and trim.

1.2 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- B. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- C. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ISO 846 - Plastics - Evaluation of the Action of Microorganisms; 2019.
- F. ISO 2812-1 - Paints and Varnishes -- Determination of Resistance to Liquids -- Part 1: Immersion in Liquids Other than Water; 2017.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

1.5 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Panels:
 - 1. Crane Composites, Inc.: www.cranecomposites.com.
 - 2. Glasteel: www.glasteel.com.
 - 3. Kemlite: www.kemlite.com.
 - 4. Marlite, Inc.: www.marlite.com/#sle.
 - 5. Nudo Products, Inc.: www.nudo.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PANEL SYSTEMS

- A. Wall Panels:
 - 1. Panel Size: As indicated on Drawings.
 - 2. Panel Thickness: 0.10 inch (2.5 mm) (2.5 mm).
 - 3. Surface Design: Embossed.
 - 4. Color: As selected by Architect from manufacturer's full line.
 - 5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.3 MATERIALS

- A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.

1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Impact Strength: Greater than 6 ft lb force per inch (320 J per m), when tested in accordance with ASTM D256.
 4. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with ISO 2812-1.
 5. Biological Resistance: Rating of 0, when tested in accordance with ISO 846.
- B. Trim: Vinyl; color coordinating with panel.
- C. Sealant: Silicone; color matching panel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.2 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 13 00 - SHEET WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-adhered modified bituminous sheet membrane.
- B. Self-adhered HDPE sheet membrane.

1.2 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.
- D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.
- F. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2018.
- G. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 2020.
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- I. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until liquid or mastic accessories have cured.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Contractor to correct defective Work within period of five years after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 SHEET WATERPROOFING APPLICATIONS

A. Self-Adhered Modified Bituminous Sheet Membrane:

1. Location:
 - a. Beneath elevated concrete balconies, stair landing, corridors.
 - b. Backfilled vertical walls where access to positive side of wall can be provided.

B. Self-Adhered HDPE Sheet Membrane:

1. Location: Below grade underslab and blind side vertical walls where cast in place concrete will be provided.

2.2 SHEET WATERPROOFING MATERIALS

A. Self-Adhered Modified Bituminous Sheet Membrane:

1. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
2. Sheet Width: 36 inches (0.914 m), minimum.
3. Tensile Strength:
 - a. Film: 5,000 psi (34.57 MPa), minimum, measured in accordance with ASTM D882 and at grip-separation rate of 2 inches (50 mm) per minute.
 - b. Membrane: 325 psi (2.24 MPa), minimum, measured in accordance with ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches (50 mm) per minute.
4. Elongation at Break: 300 percent, minimum, measured in accordance with ASTM D412.
5. Water Vapor Permeance: 0.05 perm (2.9 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
6. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F (minus 29 degrees C), 180 degree bend on 1 inch (25 mm) mandrel.
7. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
8. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 200 feet (61 m) head of water applied in accordance with test method ASTM D5385/D5385M.
9. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
10. Products:
 - a. Carlisle Coatings & Waterproofing Inc; MiraDRI 860/861: www.carlisleccw.com/#sle.
 - b. GCP Applied Technologies; Bituthene: www.gcpat.com/#sle.
 - c. Henry Company; Blueskin WP 200: www.henry.com/#sle.
 - d. W. R. Meadows, Inc; MEL-ROL LOW TEMP: www.wrmeadows.com/#sle.
 - e. Soprema, Inc; COLPHENE 3000: www.soprema.us/#sle.

B. Self-Adhered HDPE Sheet Membrane: Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.

1. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F (minus 29 degrees C), 180 degree bend on 1 inch (25 mm) mandrel.
2. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 231 feet (70.4 m) head of water applied in accordance with test method ASTM D5385/D5385M.
3. Tensile Strength, Film: 3,500 psi (24 MPa), minimum, measured in accordance with ASTM D412.
4. Adhesion: 150 psi (1.03 MPa), minimum, measured in accordance with ASTM D4541.
5. Water Vapor Permeance: 0.01 perm (0.6 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
6. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
7. Products:
 - a. AVM Industries, Inc; Aussie Skin 550G: www.avmindustries.com/#sle.
 - b. EPRO Services, Inc; PreTak: www.eproinc.com/#sle.

- c. GCP Applied Technologies; Preprufe 160R Plus/LT: www.gcpat.com/#sle.

2.3 ACCESSORIES

- A. Seaming Materials: As recommended by membrane manufacturer.
- B. Membrane Sealant: As recommended by membrane manufacturer.
- C. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
- D. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
 - 1. Semi-rigid glass fiber board; unaffected by water, freeze-thaw, fungus, or soil bacteria; containing no formaldehyde, phenol, acrylic, or artificial color; 3/4 inch (19 mm) thick, nominal.
 - 2. Products:
 - a. W. R. Meadows, Inc; Protection Course: www.wrmeadows.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
 - 1. Composition: Dimpled polystyrene, polyethylene, or polypropylene core; polypropylene filter fabric.
 - 2. Thickness: As indicated on drawings.
 - 3. Products:
 - a. W. R. Meadows, Inc; Mel-Drain 5012: www.wrmeadows.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Self-Adhered Flashing: Composite membrane with top layer consisting of Ketone Ethylene Ester (KEE) reinforced membrane and backed by bottom layer of synthetic butyl adhesive covered with release paper.
 - 1. Overall Thickness: 35 to 45 mil, 0.035 to 0.045 inch (0.89 to 1.14 mm), nominal.
 - 2. Width: 12 inches (305 mm), nominal.
 - 3. Color: Black.
- G. Preformed Flashing Shapes: Injected or vacuum molded one piece shapes used for detailing of inside and outside corners, protrusions, and transitions.
 - 1. Shapes: Provide 90 degree inside corner and 135 degree inside corner.
 - 2. Window and Special Details: Provide shapes as indicated on drawings.
 - 3. Color: Black.
- H. Flexible Flashings: Type recommended by membrane manufacturer.
- I. Termination Bars: Aluminum; compatible with membrane and adhesives.
- J. Surface Conditioner: Recommended by manufacturer, compatible with membrane.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify that items penetrating surfaces to receive waterproofing are securely installed.
- D. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.
- E. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.

- G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
 - H. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate in accordance with ASTM D5295/D5295M.
 - 1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
 - 2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in reference standard.
 - 3. Remove and replace areas of defective concrete; see Section 03 30 00.
 - 4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in referenced standard.
 - 5. Test concrete surfaces as described in referenced standards, and verify surfaces are ready to receive adhesive bonded waterproofing membrane system.
- 3.3 INSTALLATION - MEMBRANE
- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
 - B. Roll out membrane, and minimize wrinkles and bubbles.
 - C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
 - D. Overlap edges and ends, minimum 3 inches (76 mm), seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
 - E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
 - F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
 - G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
 - H. Seal membrane and flashings to adjoining surfaces.
 - 1. Install termination bar along edges.
- 3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD
- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward; scribe and cut boards around projections, penetrations, and interruptions.
 - B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.
 - C. Adhere protection board to substrate with compatible adhesive.
- 3.5 FIELD QUALITY CONTROL
- A. See Section 01 40 00 - Quality Requirements for additional requirements.
 - B. Upon completion of horizontal membrane installation, dam installation area in preparation for flood testing.
 - 1. Flood to minimum depth of 1 inch (25.4 mm) with clean water, and after 48 hours inspect for leaks.
 - 2. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.
 - 3. When area is proven watertight, drain water and remove dam.
- 3.6 PROTECTION
- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 21 10 - THERMAL INSULATION - BATTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Thermal batt insulation in exterior envelope applications, unless specified as part of an assembly in other Section(s):
 - 1. Insulation in metal framed walls.
 - 2. Insulation in wood framed walls.
 - 3. Insulation in wood framed roof/ceiling structure.
 - 4. Insulation in wood framed floor/ceiling structure.
 - 5. Insulation in wood framed ceiling structure.

1.2 REFERENCE STANDARDS

- A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. As specified in this Section for each insulation type and application.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 APPLICATIONS

- A. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder (and with integral vapor retarder where dew point calculations determine the need).
- B. Insulation in Wood Framed Walls: Batt insulation with no vapor retarder (and with integral vapor retarder where dew point calculations determine the need).
- C. Insulation in Wood Framed Roof/Ceiling Structure: Batt insulation with no vapor retarder (and with integral vapor retarder where dew point calculations determine the need).
- D. Insulation in Wood Framed Floor/Ceiling Structure: Batt insulation with no vapor retarder.
- E. Insulation in Wood Framed Ceiling Structure: Batt insulation with no vapor retarder (and with integral vapor retarder where dew point calculations determine the need).

2.3 INSULATION MATERIALS - GENERAL

- A. Where units are included in fire rated wall, ceiling, or floor construction, provide insulation units which have been tested and rated as required for the indicated assembly.

2.4 MINERAL FIBER BLANKET (BATT) INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Density: Minimum 0.5 pounds per cubic foot where used in rated floor/ceiling assembly and other specified assemblies if required.
 - 5. Thermal Resistance: As noted on Drawings, minimum value.
 - 6. Thickness: Full thickness of framing or cavity space indicated, unless otherwise specifically noted on Drawings.
 - 7. Facing: Provide following types, as noted on Drawings:
 - a. Unfaced for warm climates and for acoustical applications.
 - b. Asphalt treated kraft paper, one side in cold climates.
 - 8. Acceptable Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville: www.jm.com.
 - c. Knauf Insulation: www.knaufinsulation.us.
 - d. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
 - 1. Width: 3-1/2 inches (89 mm).
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
 - 3. Products:
 - a. Protecto Wrap Company; Triple Guard Energy Sill Sealer: www.protectowrap.com/#sle.
- C. Insulation Fasteners: Appropriate for purpose intended and approved by insulation manufacturer.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate.
 - 2. Length as required for thickness of insulation material and penetration of structural backing framing or substrates as indicated, with metal washers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BATT INSULATION INSTALLATION

- A. Installation - General:
 - 1. Install insulation and vapor retarder at locations indicated and in accordance with manufacturer's instructions.

2. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
 3. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
 4. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- B. Floor/Ceiling and Roof/Ceiling Assemblies: Retain insulation batts in place with wire mesh secured to framing members in accordance with tested assembly requirements.
- C. Tape seal butt ends, lapped flanges, and tears or cuts in vapor retarder membranes.
- D. 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.
- 3.3 PROTECTION
- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foamed-in-place insulation:
 - 1. In exterior wall crevices.
 - 2. In shim spaces at windows and similar locations.
 - 3. At junctions of dissimilar wall and roof materials.
- B. Protective intumescent coating.

1.2 REFERENCE STANDARDS

- A. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. FM 4880 - Examination Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials; 2022.
- D. NFPA 275 - Standard Method of Fire Tests for the Evaluation of Thermal Barriers; 2022.
- E. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- F. UL 1040 - Standard for Safety Fire Test of Insulated Wall Construction; Current Edition, Including All Revisions.
- G. UL 1715 - Standard for Safety Fire Test of Interior Finish Material; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this Section.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Certificates: Certify that products of this Section meet or exceed specified requirements.
- D. Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this Section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience.
- C. Basis of Design: Specifications are based on insulation types by specified basis of design manufacturer and product(s). Insulation types manufactured by other acceptable manufacturers are permitted, subject to compliance with specified requirements; and provided that deviations in formulation, density, and thermal performance are minor, and do not detract substantially from the indicated design intent.
 - 1. Comply with requirements specified in Section 01 40 00 and Section 01 60 00.

1.6 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. BASF Corporation: www.spf.basf.com.
 - 2. Carlisle Spray Foam Insulation: www.carlisesfi.com.
 - 3. Dow Chemical Company: www.dow.com.
 - 4. Henry Company: www.henry.com.
 - 5. Huntsman Building Solutions: www.huntsmanbuildingsolutions.com.
 - 6. Johns Manville: www.jm.com.
 - 7. NCFI Polyurethanes: www.ncfi.com.
 - 8. Rhino Linings Corporation: www.rhino linings.com.

2.2 MATERIALS

- A. Product Requirements - General:
- B. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 - 1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and fire protection requirements.
 - a. Fire Protection: Provide 15-minute thermal barrier of 1/2 inch (12.7 mm) gypsum board or equivalent material complying with NFPA 275 test method, or foamed-in-place insulation either exposed or with covering that complies with FM 4880, NFPA 286, UL 1040, or UL 1715.
 - 2. Density In Place: Minimum 2.0 lb/cu ft.; ASTM D1622.
 - 3. Basis of Design Product:
 - a. Huntsman Building Solutions; Heatlok HFO Pro: www.huntsmanbuildingsolutions.com/#sle.

2.3 ACCESSORIES

- A. Primer: As required by insulation manufacturer.
- B. Protective Coating: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.
 - 1. Coating Type: Single component, water-based.
 - 2. Protected Insulation Type: Spray polyurethane foam (SPF).
 - 3. Application: Apply using brush, roller, or airless sprayer.
 - 4. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
 - 5. Color: As indicated on drawings.
 - 6. Products:
 - a. International Fireproof Technology Inc; DC315 Intumescent Coating: www.painttoprotect.com/#sle.
 - b. International Coatings Group; FBL-100 Fire Barrier Latex: www.internationalcoatingsgroup.com/#sle.
 - c. No-Burn, Inc; Plus ThB Intumescent Coating: www.noburn.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify work within construction spaces or crevices is complete before insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.2 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.3 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids. Screed away excess foam to produce smooth and uniformly textured exposed surfaces.
- C. Apply protective coating monolithically, without voids, to fully cover foam insulation, to achieve fire rating required.
- D. Patch damaged areas.
- E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts or void applicable warranties of windows and other opening components.

3.4 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 07 26 16.16 - UNDERSLAB VAPOR RETARDER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sheet vapor retarder under concrete slabs on grade.

1.2 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
- C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; maximum permeance of 0.01 as measured according to ASTM E96/E96M; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
 - 1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder membrane.
 - 2. Acceptable Products:
 - a. Insulation Solutions, Inc.; Viper VaporCheck II 10-mil Class A: www.insulationsolutions.com.
 - b. Stego Industries, LLC; Stego Wrap Vapor Barrier 10-mil (Class A): www.stegoindustries.com.
 - c. W.R. Meadows, Inc.; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com.
 - d. Raven Industries, Inc.; VAPORBLOCK VB 15: www.ravenind.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. At structural slabs supported by pier and beam construction, provide manufacturer's recommended adhesive tape to hold membrane to bottom of slab, equal to Stego Wrap Crete Claw.
- C. Sealing and Seaming Tape: High density polyethylene tape a minimum of 4" in width, compatible with vapor retarder membrane, and manufactured by or recommended by vapor retarder membrane manufacturer. Tape for joints shall have at least the same permeability rating as the vapor retarder specified.
- D. Pipe Boot: Construct pipe boots from vapor retarder material and pressure sensitive tape in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surface over which vapor retarder is to be installed is complete and ready before proceeding with installation of vapor retarder.

3.2 INSTALLATION

- A. Install vapor retarder in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor retarder under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Fine grade under slab soils to smooth and level surface prior to installation of slab on grade edge and construction joint forms.
- D. Tamp and level subbase soil materials to within plus zero (0) inches to minus 3/4 inches from required subgrade elevation.
- E. Lap joints minimum 6 inches (150 mm).
- F. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- G. No penetration of vapor retarder is allowed except for reinforcing steel and permanent utilities.
- H. Do not disturb or damage vapor retarder while placing concrete.
- I. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

SECTION 07 27 16 - FLUID APPLIED AIR BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air barrier system accessories, including:
 - 1. Sealants, tapes, and accessories for sealing air barrier and adjacent substrates.
 - 2. Pre-formed flashing assembly at air barrier penetrations.
 - 3. Other specified system accessories.

1.2 DEFINITIONS

- A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but may be water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

1.3 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- C. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2023.
- D. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2024.
- E. ASTM E1677 - Standard Specification for Air Barrier (AB) Material or Assemblies for Low-Rise Framed Building Walls; 2023.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- H. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of weather barriers with adjacent flashings and weather barriers for compatibility and continuity of those systems.
 - 2. Coordinate installation of flexible flashing at openings with Sections that specify window, door, and other opening installations.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this Section; require attendance by all affected installers.
 - 1. Convene under general provisions of Section 01 70 00.
 - 2. Discuss installation procedures, requirements for items that penetrate the system, and other pertinent issues.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions, including special flashing conditions where incompatible materials are in close proximity to or in contact with specified air barriers.
- D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

- B. System Compatibility: Assume responsibility for confirming that weather barrier system components are compatible with each other as a system, and also compatible with substrate surfaces with which they will be in contact, including but not limited to wall and sheathing surfaces, opening materials, other flashings and weather barrier materials, and joint sealants.
 - 1. Assure that system components are compatible as specified prior to preparing and making specified submittals.
 - 2. Assume responsibility for removal of incompatible system components and installation of properly compatible components at no additional cost to Owner regardless of when incompatibility is discovered.

1.7 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Mock-up: Construct air barrier mock-up, 10 feet (3 m) long by 10 feet (3 m) wide.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of work.
- C. Build integrated mockups of exterior wall assembly, 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.
- D. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
- E. Include junction with roofing membrane, building corner condition,.
- F. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
- G. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- H. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.1 AIR BARRIER ASSEMBLIES

- A. Air Barriers:
 - 1. On outside of exterior sheathing use air barrier coating.

2.2 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

- A. Air Barrier Coating:
 - 1. Dry Film Thickness (DFT): 20 mil, 0.020 inch (0.508 mm), minimum.
 - 2. Air Permeance: 0.004 cfm/sq ft (0.02 L/(s sq m)), maximum, when tested in accordance with ASTM E2178.
 - 3. Water Vapor Permeance: 11 perms (629 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F (23 degrees C).
 - 4. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 180 days of weather exposure.
 - 5. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
 - 6. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
 - 7. Comply with NFPA 285 requirements for wall assembly.
 - 8. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
 - 9. VOC Content: Zero.

10. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
 11. Acceptable Products:
 - a. Carlisle Coatings and Waterproofing, Inc.; Fire Resist Barrithane VP: www.carlisleccw.com.
 - b. DuPont de Nemours, Inc.; Tyvek Fluid Applied WB+ with Tyvek Fluid Applied Flashing and Joint Compound, Sealant for Tyvek Fluid Applied System, and StraightFlash: building.dupont.com.
 - c. GCP Applied Technologies; Perm-A-Barrier VPL 50RS UV Stable: www.gcpat.com.
 - d. Henry Company; Air-Bloc 17MR: www.henry.com.
- B. Air Barrier Membrane:
1. Material: Water-based acrylic.
 2. Dry Film Thickness (DFT): 30 mil, 0.030 inch (0.762 mm), minimum.
 3. Air Permeance: 0.004 cfm/sq ft (0.02 L/(s sq m)), maximum, when tested in accordance with ASTM E2178.
 4. Water Vapor Permeance: 11 perms (629 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F (23 degrees C).
 5. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 180 days of weather exposure.
 6. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
 7. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
 8. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
 9. VOC Content: Zero.
 10. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
 11. Acceptable Products:
 - a. Tremco Commercial Sealants & Waterproofing; ExoAir 230: www.tremcosealants.com/#sle.
 - b. W.R. Meadows, Inc.; Air-Shield LMP: www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.
- B. Pre-formed Flashing Assembly: Semi-rigid rubber flange with semi-rigid or flexible rubber penetration hood or baffle sized to accommodate penetrating pipe, conduit, and similar items as indicated.
 1. Acceptable Product:
 - a. QuickFlash Weatherproofing Products, Inc.; QuickFlash P-Series, A/C Series, and E- Series: www.quickflashproducts.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Accessory Components: As recommended by primary weather barrier membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready for work of this Section.
- B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.
- C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.3 INSTALLATION

- A. Install materials in accordance with basis of design manufacturer's instructions and ASTM E1677, and as otherwise specified in this Section.
 - 1. Also comply with applicable requirements of ASTM E2112 for installation of air barrier materials in conjunction with installation of windows, aluminum storefronts, doors, and louvers.
- B. Air Barrier System Installation: Comply with basis of design manufacturer's requirements for high performance installation and ASTM E2357 in all respects as applicable to indicated conditions of installation, which include but are not limited to the following:
 - 1. Exceed building envelope design requirements included in ASTM E1677; minimum 65 mph equivalent structural load and minimum 15 mph equivalent wind-driven rain water infiltration resistance.
 - 2. Cover air barrier installation within 270 calendar days of installation, or sooner if specifically required by air barrier manufacturer.
 - 3. Use manufacturer's recommended primers for installation of system components in adverse weather conditions or cold weather.
 - 4. Install self-adhering flashing products according to manufacturer's printed instructions, and at temperatures above 25 degrees F, unless specifically allowed otherwise by flashing manufacturer.
 - 5. Do not allow fluid-applied membrane products to come in contact with installed air barrier system sheets; comply with sheet manufacturer's printed instructions for transitions between air barrier sheets and other fluid-applied coatings.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Fluid-Applied Coatings or Membranes:
 - 1. Prepare substrate in accordance with manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
 - 2. Cold Weather Applications: Comply with manufacturer's protocols and special application instructions.
 - 3. Apply bead or trowel coat of mastic sealant with minimum thickness of 1/4 inch (6 mm) along coating seams, rough cuts, and as recommended by manufacturer.
 - 4. Use flashing to seal to adjacent construction and to bridge joints in coating substrate.
 - 5. Provide flexible flashing or extra thickness of reinforced coating at all changes in plane, intersections with other weather barriers, flashings, and other components of the weather barrier enclosure.
- E. Openings and Penetrations in Exterior Air Barriers:
 - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto air barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
 - 2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
 - 3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
 - 4. At head of openings, install flashing under air barrier extending at least 2 inches (50 mm) beyond face of jambs; seal air barrier to flashing.
 - 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
 - 6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.
 - 7. Pre-formed Flashing Assemblies: Install bottom edge of flange over weather barrier membrane, side and top edges under weather barrier membrane, with flashing tape applied to sides and top edges in strict compliance with flashing assembly and weather barrier manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Do not cover installed air barriers until required inspections have been completed.
- C. Obtain approval of installation procedures from air barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- D. Take digital photographs of each portion of installation prior to covering up air barriers.

3.5 PROTECTION

- A. Protect installed air barrier systems and associated flashings from damage until covered by subsequent construction.
- B. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 31 13 - ASPHALT SHINGLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Asphalt shingle roofing.
- B. Flexible sheet membranes for eave protection, underlayment, and valley protection.
- C. Flashing.

1.2 REFERENCE STANDARDS

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- B. ASTM D3161/D3161M - Standard Test Method for Wind Resistance of Steep Slope Roofing Products (Fan-Induced Method); 2020.
- C. ASTM D3462/D3462M - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules; 2023.
- D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- E. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2020a.
- F. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.
- G. NRCA (RM) - The NRCA Roofing Manual; 2024.
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- I. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of roof mounted components or work projecting through roof with weather tight placement of counterflashings.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.
- C. Samples: Submit two samples of each shingle color indicating color range and finish texture/pattern; for color selection.
- D. Manufacturer's Installation Instructions: Indicate installation criteria and procedures.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Provide details of sheet metal flashing profiles and thicknesses.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing asphalt shingles, with at least 3 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store materials with labels intact in manufacturer's unopened packaging until ready for installation.
- B. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.
- C. Protect materials from harmful environmental elements, construction dust, direct sunlight, and other potentially detrimental conditions.
- D. When storing roofing materials on roofing system ensure that no damage occurs to supporting members and other materials.

1.7 FIELD CONDITIONS

- A. Do not install shingles, eave protection membrane or underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F (7 degrees C).

1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide 30 year manufacturer's warranty for coverage product degradation, and coverage against black streaks and other visible defects caused by algae.
- C. Provide 5-year manufacturer's warranty for wind damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Atlas Roofing Corporation: www.atlasroofing.com.
 - 2. GAF: www.gaf.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
 - 4. Tamko Roofing Products, Inc.: www.tamko.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 ASPHALT SHINGLES

- A. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462/D3462M.
 - 1. Fire Resistance: Class A, complying with ASTM E108.
 - 2. Wind Resistance: Class A, minimum, when tested in accordance with ASTM D3161/D3161M .
 - 3. Fire or Wind Resistance Criteria: Provide UL (DIR) listed and labeled products.
 - 4. Warranted Wind Speed: Not less than tested wind resistance.
 - 5. Algae resistant.
 - 6. Self-sealing type.
 - 7. Style: Staggered edge butt.

2.3 SHEET MATERIALS

- A. Eave and Valley Protection Membrane: Self-adhering polymer-modified asphalt sheet complying with ASTM D1970/D1970M; 40 mil (1 mm) total thickness; with strippable treated release paper and polyethylene sheet top surface.
 - 1. Acceptable Manufacturers:
 - a. GCP Applied Technologies; Ice & Water Shield: www.gcpat.com.
 - b. Polyguard Products, Inc.; Deck Guard: www.polyguard.com.
 - c. Manufacturer's proprietary or recommended product required to maintain specified warranty; compatible with specified underlayment materials.
- B. Underlayment: At Contractor's option, provide one of the following:
 - 1. Asphalt Saturated Felt: No. 30 lb un-perforated, as recommended for use in construction of built-up roofs, meeting ASTM D4869/D4869M
 - 2. Synthetic Underlayments: Meeting ASTM D8257, provide one of the following:
 - a. GAF Feltbuster
 - b. Owens Corning ProArmor
 - c. Dupont Tyvek Protec 120
 - d. UDL Pro by Barricade Building Products.
 - e. U20 by RhinoRoof.
 - f. Protectite Ultra by Epilay.

2.4 FLASHING

- A. Metal Flashing: Prefinished galvanized steel; see Section 07 62 00.

2.5 ACCESSORIES

- A. Roofing Nails: Standard round wire shingle type, galvanized steel, minimum 3/8-inch (9.5 mm) head diameter, 12-gauge, 0.109-inch (2.77 mm) nail shank diameter, 1-1/2 inches (38 mm) long and complying with ASTM F1667/F1667M.
- B. Asphalt Roof Cement: ASTM D4586/D4586M, asbestos-free.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that roof deck is of sufficient thickness to accept fasteners.
- B. Verify that roof penetrations and plumbing stacks are in place and flashed to deck surface.
- C. Verify roof openings are correctly framed.
- D. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.2 PREPARATION

- A. Seal roof deck joints wider than 1/16 inch (1.5 mm) as recommended by shingle manufacturer.
- B. At areas where eave protection membrane is to be adhered to substrate, fill knot holes and surface cracks with latex filler.
- C. Broom clean deck surfaces before installing underlayment or eave protection.
- D. Protect surrounding areas and adjacent surfaces from damage during execution of this work.
- E. Install eave edge and gable edge flashings tight with fascia boards, weather lap joints 2 inches (50 mm) and seal with roof cement, and secure flange with nails spaced maximum 12 inches (304.8 mm) on center.
 - 1. Secure at spacing required or recommended by reference standards specified in Section 07 62 00.

3.3 INSTALLATION

- A. Eave Protection Membrane (in cold weather climates):
 - 1. Install eave protection membrane from eave edge to minimum 48 inches (1,220 mm) up-slope beyond interior face of exterior wall.
 - 2. Install eave protection membrane in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
 - 3. Apply 4-inch (100 mm) wide band of plastic cement over deck flange of eave edge flashings and embed an 18-inch (450 mm) wide strip of eave protection membrane. Place starter strip with eave edge flush with face of flashings, secure in place, and lap ends minimum 6 inches (150 mm).
 - 4. Apply lap cement at rate of approximately 1.25 gal/100 sq ft (0.5 L/sq m) over starter strip.
 - 5. Starting from lower edge of starter strip, lay additional 36-inch (900 mm) wide strips in lap cement to produce a 2-ply membrane. Weather lap plies minimum 19 inches (475 mm) and nail in place; lap ends minimum 6 inches (150 mm) and stagger end joints of each consecutive ply.
- B. Underlayment:
 - 1. Roof Slopes Up to 4:12: Install two layers of underlayment over area not protected by eave protection, with ends and edges weather lapped minimum 4 inches (100 mm); stagger end laps of each consecutive layer and nail in place.
 - 2. Roof Slopes Greater Than 4:12: Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum 4 inches (100 mm); stagger end laps of each consecutive layer, nail in place, and weather lap minimum 4 inches (100 mm) over eave protection.
 - 3. Weather lap and seal watertight with plastic cement any items projecting through or mounted on roof.
- C. Valley Protection:
 - 1. Install valley protection in accordance with SMACNA (ASMM), Figure 4-10.
 - 2. Install flexible flashing in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
 - 3. At Exposed Valleys: Install minimum 36-inch (900 mm) wide roll roofing with mineral surface side up centered over first layer of protection. Apply 4-inch (100 mm) wide band of lap cement along each edge of first layer, press roll roofing into cement, nail in place minimum 18 inches (450 mm) on center and 1 inch (25 mm) from edges.
- D. Metal Flashing:
 - 1. Install flashings in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
 - 2. Weather lap joints minimum 2 inches (50 mm) and seal weather tight with plastic cement.

3. Secure in place with nails at maximum 12 inches (300 mm) on center, and conceal fastenings.
4. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.
- E. Shingles:
 1. Install shingles in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
 - a. Fasten individual shingles using two nails per shingle, or as required by manufacturer and local building code, whichever is greater.
 - b. Fasten strip shingles using four nails per strip, or as required by manufacturer and local building code, whichever is greater.
 2. Place shingles in straight coursing pattern with minimum 5-inch (125 mm) weather exposure, unless otherwise required by shingle manufacturer for specified shingle product, to produce double thickness over full roof area, and provide double course of shingles at eaves.
 3. Project first course of shingles 3/4 inch (19 mm) beyond fascia boards.
 4. Extend shingles 1/2 inch (13 mm) beyond face of gable edge fascia boards.
 5. Extend shingles on one slope across valley and fasten; trim shingles from other slope 2 inches (50 mm) from valley center line to achieve closed cut valley, concealing valley protection.
 6. Cap hips with individual shingles, maintaining 5-inch (127 mm) weather exposure, and place to avoid exposed nails.
 7. After installation, place one daub of plastic cement 1-inch (25.4 mm) diameter under each individual shingle tab exposed to weather to prevent lifting.
 8. Coordinate installation of roof mounted components or work projecting through roof with weathertight placement of counterflashings.
 9. Complete installation to provide weathertight service.
- 3.4 CLEANING
 - A. Clean exposed work upon completion of installation; remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to finish.
- 3.5 PROTECTION
 - A. Do not permit traffic over finished roof surface; protect roofing until completion of project.
 - B. Touch-up, repair, or replace damaged asphalt shingles or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 41 60 - PREFORMED METAL AWNINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal panel awning system complete with related flashings, closures, trim and accessories.
- B. Underlayment where plywood substrate is indicated.
- C. Clips, anchoring, devices, fasteners, and accessories required for installation of panel system.

1.2 SYSTEM REQUIREMENTS

- A. Performance Requirements
 - 1. Design and install system to accommodate thermal expansion, thermal contraction, and building movement.
 - 2. Design system and fasteners to resist wind uplift associated with code required wind loading.

1.3 SUBMITTALS

- A. General: Submit following items in accordance with Section 01 30 00.
- B. Product Data: Submit manufacturer's technical literature indicating properties of materials, finishes, and performance capabilities.
- C. Manufacturer's Instructions: Submit written installation instructions indicating method and sequence of installation.
- D. Provide shop drawings showing the attachment to the wall, coordination with adjacent/substrate materials, and how the fasteners are sealed air/water tight through the water resistive barrier.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with Section 01 60 00.

1.5 WARRANTY

- A. Provide warranties in accordance with Section 01 78 00.
- B. Warrant installed system to be free of leaks and free from defects in materials and workmanship.
 - 1. Warranty period: Two (2) years from date of Substantial Completion of project.
- C. Warrant factory finish to be free of cracks, splits, crazing, chipping, peeling, color fading, and rusting.
 - 1. Warranty period: Twenty (20) years from date of Substantial Completion of project.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers
 - 1. AEP Span, Dallas Corp., Dallas, TX.
 - 2. Merchant and Evans Industries, Burlington, NJ.
 - 3. E J Manufacturing,
 - 4. Berridge Manufacturing Co., Houston, TX.
 - 5. MBCI, Houston, TX.
 - 6. Architectural Fabrication, Fort Worth, TX.
- B. Substitutions: Submit in accordance with Section 01 60 00.

2.2 STANDING SEAM AWNING PANELS - ACCEPTABLE PRODUCTS

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Basis of Design: Berridge Manufacturing Double-Lock Zee-Lock Panel.
- B. Clips: Floating to accommodate thermal movement.
 - 1. Material: 0.025-inch min thick, stainless-steel sheet.
- C. Panel Coverage: 16-18 inches
- D. Substitutions: Submit in accordance with Section 01 60 00.

2.3 MATERIALS AND COMPONENTS

- A. Sheet Steel: ASTM A792, Galvalume (Aluminum Zinc Alloy), smooth finish, minimum 24 gauge.
- B. Sealants and Gaskets: Manufacturer's standard type suitable for use with installation of metal awning; non staining; skinning, non shrinking and non sagging; ultra violet and ozone resistant for exterior applications; color to match exposed metal.
- C. Fasteners: Manufacturer's standard type to suit applications; with soft neoprene washers; galvanized in accordance with ASTM A153; finished to match metal panels where exposed.
- D. Powder Actuated Fasteners: Galvanized in accordance with ASTM A153, with soft neoprene washers, finished to match metal panels where exposed.
- E. Internal and External Corners: Same materials, gage and finish as panels; profile to suit system; brake formed to required angles. Mitered internal corners, back braced with sheet stock, to maintain continuity of profile.
- F. Trim, Closure Pieces, Cap, Fascias, Infills, Flashings and Accessories: Same material, gage, and where exposed, of same finish as metal panels, brake formed to required profiles.
- G. Underlayment (if installed over solid sheathing): 40 mil peel and stick rubberized asphalt membrane, VyCor enV-S or Ice and Water Shield HT, both by GCP Applied Technologies(Grace). www.gcpat.com.
- H. Touch up Paint: As recommended by manufacturer.
- I. Finish: 2-Coat Fluoropolymer: AAMA 621. 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.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.4 FABRICATION

- A. Uniformly dimensioned, roll formed to exact lengths to avoid field cutting; intermediate horizontal seams not permitted.
- B. Fabrication of component profiles on site not permitted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces for conditions that would adversely affect execution. Do not proceed until unsatisfactory conditions are corrected. Beginning of execution will constitute acceptance of existing conditions.
- B. Inspect subawning to verify conditions are acceptable prior to beginning installation. Verify substrate is uniform and even.

3.2 INSTALLATION

- A. Install metal awning and related components in accordance with manufacturer's printed instructions. Fasten panels with concealed metal clips at each side joint.
- B. Install trim, closures, caps and accessories as indicated or required for complete weathertight installation.
- C. Protect surfaces in contact with cementitious materials and dissimilar metals with application of bituminous paint. Allow to dry prior to installation.
- D. Permanently fasten system to structure at spacings required by panel manufacturer. Align, level, and plumb, within specified tolerances. Use concealed fasteners unless approved otherwise by Architect. Provide expansion and control joints where indicated.
- E. Seal and place gaskets to prevent weather penetration.
- F. Tolerances
 - 1. Maximum Offset from True Alignment Between Adjacent Members Butting or In line: 1/16 inch.
 - 2. Maximum Variation from Plane or Location Indicated on Drawings: 1/8 inch.
- G. Take special precautions in handling and installing bare Galvalume panels so that finish is not defaced or marred. Utilize tennis shoes, cloth gloves, and other apparel and precautions as recommended by metal manufacturer.

3.3 PROTECTION

- A. Protect system from damage, staining or soiling after installation. Replace components which have been scratched, dented, or otherwise showing signs of damage or improper installation.

END OF SECTION

SECTION 07 46 46 - FIBER CEMENT SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiber cement siding systems, including:
 - 1. Siding panels.
 - 2. Soffit panels.
 - 3. Accessories and trim.

1.2 REFERENCE STANDARDS

- A. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets; 2022, with Editorial Revision (2023).
- B. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- E. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Manufacturer's detailed installation manual, including requirements for all installation methods, including fastening requirements, flashing requirements, and termination details.
- C. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified in this Section with not less than three years of documented experience.
- B. Basis of Design: Specifications are based on wall panel systems by specified basis of design manufacturer. Wall panel systems manufactured by other acceptable manufacturers are permitted, subject to compliance with specified requirements, and provided that deviations in design, composition, and profile are minor, and do not detract substantially from the indicated design intent.
 - 1. Comply with requirements specified in Section 01 40 00 and Section 01 60 00.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.
- C. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - 2. Structural failures including cracking and deforming.
 - 3. Deterioration of materials beyond normal weathering.

4. Warranty Period: 30 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer - Fiber Cement Siding:
1. James Hardie Building Products, Inc.: www.jameshardie.com.
- B. Other Acceptable Manufacturers:
1. Allura, a division of Plycem USA, Inc.: www.allurausa.com.
 2. GAF: www.gaf.com.
 3. Nichiha USA, Inc.: www.nichiha.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 FIBER CEMENT SIDING

- A. Fiber Cement Siding: Individual boards made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges.
1. Surface Burning Characteristics: Flame spread index of 0, smoke developed index of 6, maximum; when tested in accordance with ASTM E84 (Class I/A).
 2. Flammability: Noncombustible, when tested in accordance with ASTM E136.
 3. Fly Ash Content: None; not permitted.
 4. Water Vapor Transmission: Less than 7.0 perm-inch (10 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 5. UV Resistance: No cracking, checking, or erosion, when tested for 2000 hours in accordance with ASTM G155.
- B. Horizontal Lap Siding: Individual boards with specified face texture and finish.
1. Style: Standard lap style.
 2. Texture: Smooth or simulated wood grain as indicated on Drawings.
 3. Length: 12 ft (3.7 m), nominal.
 4. Width (Height): 5-1/4 inches (133 mm) or as otherwise indicated on Drawings.
 5. Thickness: 5/16 inch (8 mm), nominal.
 6. Finish: Factory applied primer.
- C. Panel Siding System: Wall panels with machined edges, for concealed clip attachment.
1. Length (Height): 96 inches (2400 mm), nominal.
 2. Texture: Smooth or otherwise indicated on Drawings.
 3. Finish: Factory applied primer.
 4. Battens: Where indicated, provide fiber cement board battens at spacing indicated.
- D. Soffit Panels: Individual boards with specified face texture and finish.
1. Texture: Smooth, with manufacturer's standard perforations for ventilation.
 2. Length: 96 inches (2440 mm), nominal.
 3. Width: 24 inches (600 mm).
 4. Thickness: 5/16 inch (8 mm), nominal.
 5. Style: Smooth or wood grain texture (as indicated on Drawings), perforated for soffit ventilation to provide minimum 5 square inches of net free area per lineal foot where indicated, widths as detailed on Drawings.
 6. Finish: Factory applied primer.
 7. Manufacturer: Same as siding.
- E. Facia and Trim Boards: Individual boards with specified face texture and finish.
1. Thickness: 3/4 and 5/4, nominal.
 2. Style: Smooth or textured to match siding, widths as detailed on Drawings.
 3. Finish: Factory applied primer.
 4. Color: As selected from manufacturer's standard range.
 5. Manufacturer: Same as siding.
- F. Wood Look Texture/Color Applied over Over Lap Siding:

1. Acceptable Manufacturer: Woodtone, Chilliwack, BC, Canada V2R 4H5; 800-663-9844; www.woodtone.com
2. Product: Rustic Series Lap Siding by Woodtone Building Products.
3. Textures: Re-sawn Face.
4. Finish: Color as selected by Architect; Factory finish with 15 year warranty.

2.3 ACCESSORIES

- A. Furring Strips - Plastic (behind sheet siding): Mold resistant, nonabsorptive entangled polymer that promotes drainage and cross ventilation.
 1. Width: Manufactur
 2. Thickness: 3/8 inch (10 mm), nominal.
 3. Length: 25 feet (7.6 m).
 4. Acceptable Products:
 - a. Keene Building Products; Easy-Fur - Rollable Furring Strip: www.keenebuilding.com/#sle.
 - b. Cor-A-Vent Sturdi-Strip
- B. Metal Trim System: Extruded aluminum, 6063-T5 alloy-temper; nominal 1 inch face width with 1/2 inch reveal; channels designed to accept siding panels of specified thickness.
 1. System Components: Include horizontal reveals, vertical reveals, outside corners, intersection profiles, and other trim profiles as indicated on Drawings.
 2. Dimension and Layout: As indicated on Drawings.
 3. Acceptable Manufacturer:
 - a. Easytrim Reveals, Inc.; EZ-Series Trim: www.easytrimreveals.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Fasteners: Galvanized or corrosion resistant type; length as required to penetrate minimum 1-1/4 inch (32 mm) into solid backing, except as otherwise specified.
 1. Use of siding manufacturer's recommended fasteners is required, to establish and maintain specified warranty, and for proper and complete installation.
- D. Sealant: Elastomeric, polyurethane or silyl-terminated polyether/polyurethane, or as otherwise recommended by siding system manufacturer; capable of being painted. Comply with general requirements specified in Section 07 92 00.
- E. Insect Screen Mesh: Vinyl-coated fiberglass, 18 x 16 mesh.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Verify that weather barrier system has been installed over substrate completely and correctly.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Protect surrounding areas and adjacent surfaces during execution of this work.
- B. Prime or pre-paint field-cut edges prior to installation.
- C. Install sheet metal flashing properly lapped with other components of the weather barrier system, and properly sloped to drain and weep moisture to the exterior.
 1. Above door and window trim and casings.
 2. Above horizontal trim in field of siding.
 3. Components specifically required or recommended by siding manufacturer for installation conditions indicated.
 4. Install insect screen mesh at bottom and open edges of installations.

3.3 INSTALLATION

- A. Allow space for thermal movement between both ends of siding panels that butt against trim; seal joint between panel and trim with specified sealant.
- B. Minimum Fastener Penetration: Comply with applicable code, but at minimum as follows:
- C. Do not install siding less than 6 inches (150 mm) from surface of ground nor closer than 2 inch (25 mm)es to roofs, patios, porches, sidewalks, and other surfaces where water may collect, unless otherwise specifically allowed by siding manufacturer or otherwise detailed on Drawings to comply with siding manufacturer's recommendations.
- D. Sealants: After siding system installation, seal all joints except lap joints of lap siding and other joints not required to be sealed according to system manufacturer's installation instructions. Seal around all penetrations through panel system.
 - 1. Exceptions: Do not seal joints between siding components and sheet metal flashings, between bottom edge of siding panels and adjacent materials, and similar locations where moisture must be allowed to weep out from behind siding system.

3.4 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Clean faced panels in accordance with manufacturer's maintenance instructions, using cleaning materials and methods acceptable to manufacturer.

3.5 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including:
 - 1. Low-slope roofing system flashings and trim.
 - 2. Formed metal copings.
 - 3. Gutters.
 - 4. Scuppers.
 - 5. Downspouts.
 - 6. Sheet metal flashing and trim accessories.
 - 7. Other sheet metal flashing and trim items indicated on Drawings and not specified in other Sections.
- B. Sealants for joints within sheet metal fabrications.
- C. Precast concrete splash pads.
- D. Design of attachment systems to comply with specified requirements.

1.2 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with roofing work for scheduling installation of counterflashing, rain drainage and similar items related to roofing.
 - 2. Coordinate with the work of Section 07 92 00 for installation of related sealants.
- B. Sequencing: Do not proceed with installation of flashing and sheet metal work until substrate construction, cants, blocking, reglets, and other construction are ready to receive the work of this Section.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 6 x 6 inch (150x150 mm) in size illustrating each specified metal finish and color.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated or specified.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion. Defective work includes failure of watertightness or seals.
- C. Provide 20 year manufacturer warranty for prefinished sheet metal materials. Warranty shall include degradation of metal finish.

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM ASSEMBLIES

- A. General: Design sheet metal flashing and trim assemblies to physically protect roofing systems, roof accessories, and other building elements and systems from damage that would permit water leakage to building interior under all weather conditions.
- B. Flashing Assemblies: Design flashing assemblies to withstand structural movement, thermally induced movement, and exposure to wind and weather without failure or permanent deformation.
- C. Roof Edge Flashing and Coping Assemblies: Design assemblies to comply with the following requirements.
 - 1. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1, RE-1, RE-2, and RE-3 as applicable to positive and negative design wind pressure as defined by applicable code.
 - 2. Movement: Capable of withstanding structural movement, thermally induced movement, and exposure to wind and weather without failure or permanent deformation.

2.2 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal.
 - 1. Applications: Flashings and counterflashings at roofing locations, concealed from public view, and similar locations.
- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.
 - 1. Applications: Flashings and counterflashings exposed to public view, and where specifically indicated on Drawings.
 - 2. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 3. Color: As selected by Architect from manufacturer's full colors.
- C. Pre-Finished Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 24-gauge, 0.0239-inch (0.61 mm) thick; plain finish shop pre-coated with silicone modified polyester coating.
 - 1. Applications: Gutters and downspouts, and where specifically indicated on Drawings.
 - 2. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; pretreated metal with two-coat system including primer and color coat with at least 70 percent PVDF coating.
 - 3. Color: As selected by Architect from manufacturer's standard colors.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats and starter strips of same material as exposed sheet, one gage thickness heavier than exposed sheet, and interlockable with exposed sheet.
 - 1. Provide continuous cleat strips for metal copings and flashings.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- H. Fabricate flashings to allow toe to extend minimum 2 inches (50 mm) over roofing terminations. Return and brake edges.
- I. Reglet Counterflashings: Form upper edge with snap-lock flange to engage the reglet receiver, and to provide spring action pressure at bottom edge against roof base flashings.
- J. Flashings for Shingle Roofs: Fabricate miscellaneous metal flashings according to the following SMACNA (ASMM) details or as recommended by tile manufacturer:
- K. Gravel Stops: Form corners by mitering and riveting flange, and seal with solder joint on concealed side. Form joints with 3/16 inch expansion space between sheets and 6 inch wide cover plates formed to same profile of gravel stops and fascias.
 - 1. Use heavier than minimum specified gage metal where profiles or other indicated conditions will likely result in distortion or oil-canning over 150 degree F temperature range.
 - 2. Where gutters are shown directly under gravel stop, extend gravel stop over gutter flange minimum 2 inches, and fold back edges.
 - 3. Comply with SMACNA (ASMM) Figure 2-1.
- L. Formed Metal Copings: Fabricate cross joints between coping sheets with 3/16 inch expansion joint between sheets, and 6 inch wide cover plate formed to profile of coping. Form cross joints in coping according to SMACNA (ASMM). Miter, seam, and seal corners of coping.
 - 1. Comply with SMACNA (ASMM) Figure 3-7A.
- M. Provide for thermal expansion/contraction of all exposed sheet metal work exceeding 15 feet in running length, except as otherwise indicated.
 - 1. Valleys and Gutters: 40 feet maximum spacing, and located at high points in drainage wherever possible. One-piece gutters may be up to 60 feet long. Reduce spacing to 20 feet maximum for aluminum materials.
 - 2. Wall Copings, Flashings and Trim: 10 feet maximum spacing, and not closer than 24 inches from corners and intersections.

2.4 GUTTER, SCUPPER, AND DOWNSPOUT FABRICATION

- A. Gutters and Downspouts: Form to profiles as required to properly collect and remove water. Fabricate complete with required connection pieces to maintain watertight joints.
 - 1. Gutters: Comply with SMACNA (ASMM) Figure 1-12.
 - 2. Downspouts: Comply with SMACNA (ASMM) Figures 1-32E/1-32H.
 - 3. Size as indicated on Drawings.
- B. Scuppers: Fabricate to SMACNA (ASMM) and as detailed on Drawings. Fabricate in two sections, with roof side flanges secured first, then outside flanges attached after insertion through wall opening. Form edges of outside flange with snap-lock flange to engage scupper receiver and to create spring action against the outer wall surface.
 - 1. Scuppers: Comply with SMACNA (ASMM) Figure 1-26.
 - 2. Conductor Heads: Comply with SMACNA (ASMM) Figure 1-25C.
 - 3. Nominal opening sizes as indicated on Drawings.
- C. Accessories: Profiled to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 - 2. Gutter Supports: Brackets.
 - 3. Downspout Supports: Straps; configured to provide 1/2 inch clear spacing from wall surface.
- D. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.

2.5 ACCESSORIES

- A. Primer Type: Zinc chromate.
- B. Protective Backing Paint: Asphaltic mastic, ASTM D4479/D4497M, Type I.
- C. Concealed Sealants: Non-curing butyl sealant; compatible with metals and roofing system membranes.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.
- C. Metal Wall Caps and Copings: Verify that wood grounds and nailing boards are secured to building framing sufficiently to resist specified pull-off resistance requirements.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.3 INSTALLATION - GENERAL

- A. Conform to Drawing details; if not detailed on Drawings, comply with standard details of the following:
 - 1. Steel Sheet Metal: SMACNA (ASMM).
 - 2. Aluminum Sheet Metal: SMACNA (ASMM).
- B. Lapped Seams - General: Overlap seams 4 inches, and seal with two continuous beads of non-curing butyl sealant spaced 2 inches apart and located 1 inch from end of each metal sheet.
- C. Cleats and Edge Strips: Secure edges of sheet metal members over 12 inches wide, and at other indicated locations with cleats. Fasten cleats at maximum 12 inches on center unless otherwise indicated. Provide continuous edge strips at eaves and gable ends for attaching exposed terminating edge of copings, gravel stops, or fascias. Provide minimum 1/8 inch butt joints as required to accommodate thermal movement.
- D. Gravel Stops and Fascias: Fill space between gravel stop and cover plate with roofing cement. Nail cover plate to deck at expansion joint. Extend flange of gravel stop out on top of roofing membrane not less than 3-1/2 inches. Set in roofing cement or mastic sealer and nail to wood nailers with one inch long #12 flathead annular head nails at 3 inches on center, staggered. Provide continuous interlocking edge strip where gravel stop extends down to form a finished fascia.
- E. Formed Metal Copings: Extend front and back edges of coping down over continuous interlocking edge strip. Terminate rear edge with hemmed and folded edge over roof base flashings, or interlock with adjacent flashings as indicated. Miter, seam, and seal corners.
- F. Surface Mounted Reglet Flashings and Counterflashings: Place surface mounted reglet not less than 9 inches above top of cant strip. Place sealant in preformed groove on back of reglet and on lap before installation. Secure reglet to wall with power driven pins through neoprene washers spaced not less than 16 inches on center. Fill top groove with elastomeric sealant specified in Section 07 92 00. After roofing is installed, install snap-lock counterflashing.
- G. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.
- H. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
- I. Apply compatible sealant between metal flashings and roofing system flashings.
- J. Isolate sheet metal from cementitious materials and dissimilar metals with underlayment or protective coating that is compatible with all other materials with which it will come in contact.
- K. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- L. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:
- M. Seal metal joints watertight.

3.4 INSTALLATION - PRE-FINISHED SHEET METAL

- A. Take special care in the handling and installation to avoid damage to finish.
- B. Remove protective film from each unit after installation, but not before adjacent construction is complete.

- C. Touch up minor damage or defects to match factory finish. Replace units which are excessively damaged as determined by Architect.

3.5 INSTALLATION - ALUMINUM

- A. Bed aluminum base members in plastic cement, anchor and seal in accordance with manufacturer's instructions.
- B. Remove protective film from each unit after installation, but not before adjacent construction is complete.
 - 1. Clean exposed surfaces immediately to prevent the start of non-uniform oxidation or electrolytic action.
- C. Apply protective backing paint to concealed surfaces which will be in contact with cementitious materials, dissimilar metals, wood, or other absorptive substrates.

3.6 INSTALLATION - GUTTERS AND DOWNSPOUTS

- A. Install as recommended by SMACNA (ASMM) and manufacturer. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Apply bituminous paint on surfaces to be in contact with dissimilar materials.
- C. Slope gutters minimum 1/8 inch per foot.
- D. Secure downspouts to wall with 3 inch wide steel straps, spaced not more than 8 feet oc. Fasten straps or clamps to building with non-corrosive expansion screws.
- E. Set splash pad under each downspout.

END OF SECTION

SECTION 07 62 10 - FLEXIBLE FLASHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed Products: Concealed flashing within wall assemblies where indicated or otherwise where required to protect and shed incidental water to the exterior.
2. Should flashing come in contact with primary air/moisture barrier, confirm compatibility with selected product from this section.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Flashing and trim assemblies as indicated shall withstand structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
1. 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces

1.3 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened packaging with all labels intact.
- B. Storage and Protection: Comply with manufacturer's instructions and recommendations. Protect products from freezing and hot temperatures. Store only as much material at point of use as required for each day's work.
- C. Do not store flashing materials in contact with other materials that might cause staining, denting, or other surface damage. Store flashing materials away from uncured concrete and masonry.
- D. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 PRODUCTS

2.1 FLEXIBLE FLASHING

- A. Self-Adhesive flexible flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mils. Products must be compatible with air/moisture barriers specified in Sections 072500 and 072726. Provide letter of acceptance from air/moisture barrier manufacturer.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Basis of Design: Dupont; Dupont Flexwrap.
 - b. Carlisle Coatings & Waterproofing; CCW-705 Air & Vapor Barrier Strips.
 - c. Grace Construction Products; Ice and Water Shield HT.
 - d. Henry; Blueskin SA

2.2 HIGH TEMPERATURE FLASHING

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by manufacturer.
 - 1. Thermal Stability: ASTM D1970/D1970M ; stable after testing at 240 deg F.
 - 2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, separators, sealants, and other miscellaneous items as required for complete metal flashing installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

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.
 - 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.
- B. For the record, 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 PREPARATION

- A. Follow manufacturer's instruction regarding substrate preparation and do not apply to concrete masonry, or OSB without doing so first.

3.3 FLASHING INSTALLATION

- A. General: Install as indicated on Drawings and per Manufacturer's recommendations.
- B. Do not install self-adhering flashing in snow, rain, fog, or mist.
- C. Do not apply self-adhering flashings to a damp or wet substrate.
- D. Do not install self-adhering flashing when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer of the self-adhering butyl flashing
- E. Self-Adhering Sheet Flashing: Install self-adhering sheet flashing, wrinkle free. Apply primer if required by flashing manufacturer. Comply with temperature restrictions of flashing manufacturer for installation. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover flashing with subsequent construction within 14 days.
- F. Location:
 - 1. Flexible Flashing: As indicated on drawings, and at all exterior windows, doors or other penetrations where high temperature flashing is not required.
 - 2. High Temperature Flashing: As indicated on drawings, or at all locations where flashing will be in contact with metal coping or metal panels where high temperatures exist.

3.4 PROTECTION

- A. Perform protective measures as recommended and required by flashing manufacturer, to prevent mechanical damage and deterioration from ultra-violet (sun) exposure. Rubberized-asphalt flashings (except for those laminated with aluminum foil), and butyl rubber flashing with a top surface of polyethylene should not be left exposed to the weather.

END OF SECTION

SECTION 07 72 10 - ROOF ACCESSORIES - STEEP SLOPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof and soffit ventilators.

1.2 SUBMITTALS

- A. General: Submit following items under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Indicating performance and physical characteristics of roof ridge ventilators and accessories proposed for use.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods, including: data on unit construction, size, configuration, joint methods and attachment method.
 - a. For all others, show required clearances, fabrication and installation details, methods of field assembly and flashing, dimension, weight.
 - 5. Maintenance requirements.
- C. Color Charts: Manufacturer's standard pre-finished product charts showing actual physical coating.
- D. Manufacturer's Instructions: Printed manufacturer's installation instructions.
- E. Warranty: Two copies of watertightness warranty, and finish coating warranty on pre-finished products.
- F. Submit samples under provisions of Section 01 30 00.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in roofing work with 3 years minimum experience in similar sized installations.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products under provisions of Section 01 60 00.
- B. Stack pre-formed material to prevent twisting, bending, and abrasions, and to provide ventilation.
- C. Prevent contact with materials which may cause discoloration or staining.
- D. Ship pre-coated products with strippable covering.

1.5 WARRANTY

- A. Provide warranties under provisions of Section 01 78 00.
- B. Provide 2-year watertightness guarantee beginning at substantial completion including repair or replacement of defective materials and workmanship.

PART 2 PRODUCTS

2.1 LOW PROFILE ROOF VENT (PROVIDE WHERE INDICATED)

- A. Galvanized, low profile.
- B. Small:
 - 1. Net Free Area: 50 square inches, minimum.
 - 2. Acceptable Product: RVA-51 by Air Vent Inc.

2.2 POLYESTER COMPOSITE RIDGE VENT (PROVIDE WHERE INDICATED)

- A. Material: Single layer, non-fabric covered, modified polyester, non-woven, non-wicking, fiber-based matting of three-dimensional construction.
- B. Net Free Area: 16.9 square inches per linear foot if hand nailed; 14.1 s.f. if nail gun is used.
- C. Size: 10.5 inches wide by 0.75 inches thick; coil length 20 feet.
- D. Acceptable Product:
 - 1. Cobra Exhaust Vent as manufactured by GAF Materials Corporation.

2.3 CONTINUOUS SOFFIT VENTS (PROVIDE WHERE INDICATED)

- A. Continuous Soffits Vents:
 - 1. 2 inch wide by 8 feet long, bi-directional aluminum louvers.
 - 2. Acceptable Product: SA Series Aluminum Soffit-Strip as manufactured by Ampcor, Taylorsville MS, 1-800-647-7063.

2.4 FABRICATION:

- A. Form sections true to shape, accurate in size, square, free from distortion and defects, to profiles indicated in accordance with SMACNA Architectural Sheet Metal Manual.

2.5 ACCESSORIES

- A. Fasteners
 - 1. Nails: AISI Series 300 for stainless and galvanized steel; aluminum for aluminum sheets. Use annular ring shank type, No. 12 gage or larger to suit application, of sufficient length to penetrate backing material at least 7/8 inch.
 - 2. Screws and Bolts: AISI Series 300 for stainless and galvanized steel; and aluminum for aluminum sheets; of sufficient size and length to sustain imposed stresses.
- B. Protective Back Paint: Zinc chromate alkyd.
- C. Sealants: One component polyurethane, non-sagging, sealant as specified in Section 079000.
- D. Plastic Cement: FS SS-C-153, Bituminous plastic cement.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to receive work of this section. Notify General Contractor of any existing conditions which will adversely affect execution. Beginning of execution will constitute acceptance of existing conditions.

3.2 PREPARATION

- A. Field measure site conditions prior to fabricating work.

3.3 INSTALLATION

- A. Soffit Vents: Ensure that adequate blocking or barriers are installed to prevent insulation from impeding air flow.
 - 1. Install soffit vents along entire length of soffits or per manufacturer.
- B. Ridge Vents: Verify that there is a clear continuous air space between sheathing and each side of ridge board per the manufacturer's requirements centered on ridge.
 - 1. Install ridge vents along entire length of roof ridges stopping six inches from each end or per manufacturer
- C. Roof Vents:
 - 1. Cut vent hole through sheathing as specified by the manufacturer for the type of vent to be installed.
 - 2. Install leak barrier, centered around the hole per manufacturer
 - 3. Install according to manufacturer's instructions for flashing vent penetrations
 - 4. Install vents in sufficient quantity to equal or slightly exceed the required exhaust vent area, calculated as specified.
 - 5. Locate roof vents no closer than 6 feet to valleys or hips.
- D. General: Install slightly more low vent net free ventilated area than high vent net free ventilated area to prevent negative attic pressure
- E. Install using skilled workmen in accordance with manufacturer's printed instruction and recommendations.
- F. Conform to drawing details included in manuals published by AA and NRCA.
- G. Provide electrolytic separation between dissimilar metals with protective back paint.
- H. On soldered metal joints, make watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

3.4 CLEANING

- A. Perform final cleaning under provisions of Section 01 70 00.

3.5 PROTECTION

- A. Protect finished installation under provisions of Section 01 50 00.

END OF SECTION

SECTION 07 84 00 - FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems, materials, and accessories.
- B. Firestopping at electrical junction boxes in fire-rated walls.
- C. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on Drawings or not, and other openings indicated.
- D. Contractor's responsibility for determining required scope of firestopping system work, and for determining applicable tested/listed systems for the entire project, and for securing jurisdictional authority approval of firestopping systems.

1.2 DEFINITIONS

- A. Firestopping: A material or combination of materials used to retain the integrity of fire- and smoke-rated construction by maintaining an effective barrier against the spread of flame, and to impede the passage of smoke, gases, and moisture through penetrations, blank openings, construction joints, and perimeter fire/smoke containment in or adjacent to fire-and smoke-rated wall, floor, ceiling, and other rated construction assemblies.
- B. Assembly: Particular arrangement of materials specific to type of construction described or detailed in referenced UL or other approved design.
- C. Barrier: Time-rated fire walls, smoke barrier walls, time-rated floor/ceiling assemblies, and structural floors.
- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is interrupted.
- E. Membrane Penetration: An opening made through one side of an assembly without passing completely through the assembly.
- F. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, top of wall and ceiling, structural floors or roof decks, and adjacent sections of structural floors.
- G. System: Specific products and applications, classified and numbered by UL or other approved testing agency to close specific barrier penetrations.
- H. Sleeve: Metal fabrication or pipe section extending through thickness of barrier used to permanently guard penetration.
- I. VOC: Volatile organic compound(s).

1.3 REFERENCE STANDARDS

- A. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- C. ASTM E1399 - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- F. IFC (GUIDE) - International Firestop Council Recommended Guidelines for Evaluating Firestop Systems Engineering Judgements; current edition.
- G. ITS (DIR) - Directory of Listed Products; Current Edition.
- H. FCIA - Firestop Contractors International Association Manual of Practice; current edition.
- I. FM (AG) - FM Approval Guide; Current Edition.
- J. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- K. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- L. UL (DIR) - Online Certifications Directory; Current Edition.

- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of firestopping systems with affected trades and adjacent work.
- B. Sequencing: Sequence work to permit firestopping materials to be installed after adjacent and surrounding work is complete.
 - 1. Do not cover or conceal firestopping installations until Owner's inspection agency and jurisdictional authority have inspected each installation.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Product Certificates:
 - a. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the joint firestopping products for installation with or near its piping system.
 - b. Certifying the joint firestopping products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.
- F. Jurisdictional Authority Submittal: After review and approval of specified submittals by Architect, submit to jurisdictional authority and local fire department complete product data indicating proposed product characteristics, performance characteristics, limitation criteria, and documentation of proposed firestop materials and systems for actual project conditions.
 - 1. Include manufacturer's complete installation instructions and UL Design or other approved testing agency data sheets for each proposed firestop system.
 - 2. Include complete test data forms or jurisdictional acceptance for proposed assemblies not conforming to specific UL Design numbers or other approved testing agency system designs.
 - 3. Submit certificate from authority having jurisdiction indicating approval of materials and systems to be used, with one complete copy, for information only, of the approved jurisdictional authority submittal.
- G. Installer's qualification statement.

1.6 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Installer Qualifications: Company specializing in performing the work of this Section and:
 - 1. Trained by manufacturer.
- C. Obtain firestop systems for each type and condition of penetration from a single manufacturer; intermixing of system components for each type and condition of penetration by different manufacturers is not permitted.
- D. Listed and tested assemblies and systems must be utilized, if they exist, before alternative systems requiring Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) will be considered. Comply with IFC (GUIDE) and FCIA for EJ and EFRRA design and submittal requirements.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver materials in original unopened containers identified with manufacturer's brand designation and applicable UL label.
- B. Do not use damaged or expired materials.

1.8 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Include agreement to repair or replace joint sealers which fail in joint adhesion, extrusion resistance, migration resistance, general durability, or apparent deterioration beyond manufacturer's printed limitations for stipulated warranty period from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop.
 - 2. A/D Fire Protection Systems Inc.: www.adfire.com.
 - 3. Everkem Diversified Products, Inc.: www.everkemproducts.com/#sle.
 - 4. GCP Applied Technologies: www.gcpat.com.
 - 5. Hilti, Inc.: www.hilti.com/#sle.
 - 6. Nelson FireStop Products: www.nelsonfirestop.com.
 - 7. Pecora Corporation: www.pecora.com.
 - 8. RectorSeal: www.rectorseal.com.
 - 9. Specified Technologies Inc.: www.stfirestop.com/#sle.
 - 10. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 11. USG: www.usg.com.
 - 12. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS - GENERAL

- A. Firestopping Materials: Any materials meeting requirements specified.
 - 1. Comply with ASTM E814, UL 1479, and UL 2079 as applicable to achieve indicated fire ratings.
- B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to Drawings for required systems and ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. General: Use firestopping systems which are acceptable for those applications for which they are specifically designed. Use of other UL listed systems is Contractor's Option, subject to compliance with specified performance, regulatory, and quality assurance requirements.
 - 1. Where there is no specific tested and classified firestop system for an indicated condition, obtain from the firestopping system manufacturer an Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) according to IFC (GUIDE) and FCIA.
- B. Scope: Install firestopping at all locations requiring protected openings where piping, conduit, cables, sleeves, ductwork and similar items penetrate fire-resistive, fire-rated, and smoke assemblies, including but not limited to:
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
 4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- D. Fire Rated Construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces and types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- E. Smoke Barrier Construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- F. Other General Characteristics:
1. Surface Burning: ASTM E84 and UL 723; flame spread less than 25, smoke developed less than 450.
 2. Air Leakage of Perimeter Firestopping Barriers and Penetrations: UL 2079; L-rating less than 2.0 cfm/sf or 5.0 cfm/lf as applicable to the type and location of joint.
 3. Durability and Longevity: Permanent.
 4. Side Effects During Installation: Non-toxic.
 5. Side Effects Under Fire Exposure: Non-toxic.
 6. Long Term Side Effects: None.

2.4 MATERIALS

- A. Putty Compound: 100 percent solids intumescent or vinyl-type formulation, free of asbestos, silicones, solvents, halogens, PCB's, and inorganic fibers; flame spread/smoke developed rating 0/0 when tested in accordance with ASTM E84; paintable, not sensitive to freezing after set.
- B. Sealant Compound: One-part intumescent, endothermic, ablative, or elastomeric acrylic water-based caulking material required by applicable UL Design; flame spread/smoke developed rating 0/0 when tested in accordance with ASTM E84.
- C. Spray-Applied Compound: Water-based, flexible coating which dries to form a flexible seal; tested in accordance with ASTM E1399, complying with wind sway and thermal category, 500 cycles at minimum 10 cycles/minute.
- D. Foam Compound: Two-part, liquid-silicone elastomer formulated to foam in place when mixed; flame spread/smoke developed rating 0/0 when tested in accordance with ASTM E84.
- E. Plastic Pipe Device: Intumescent strip material, factory or site fabricated in flexible metal collar with adjustable, screw-tightened stainless steel clamp; UL classified for use with PVC, CPVC, CCPVC, CCABS, PVDF, PP, PB, and FRPP plastic pipe.
- F. Fire-Safing Insulation: ASTM C612, Type I; high-melt mineral fibers and resinous binders formed into blankets, density not less than 4.0 lbs/cu ft, tested for 3-hour fire containment for required depths and dimensions.
- G. Firestopping Pads: Intumescent, dielectric fire putty formed to 7 x 7 or 9.5 x 9.5 inch self-adhering pads, 2-hour fire rating listed by UL.

2.5 ACCESSORIES

- A. Provide necessary accessory materials specified in UL Design to achieve complete firestop system at each penetration. Include collars, sleeves, attachment devices, intumescent materials, and other items required.
- B. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design, and as recommended by firestopping manufacturer for specific substrate surfaces.
- C. Dam Material: Mineral fiberboard, mineral fiber matting, sheet metal, alumina silicate fire board, or other permanent material required as part of the firestopping system, or removable if not specifically required as part of the firestopping system.
- D. Retainers: Impale type clips to support mineral fiber safing blankets.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this Section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing or damming materials required to arrest liquid material leakage.

3.3 INSTALLATION - GENERAL

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Apply firestopping materials in sufficient thicknesses to achieve scheduled fire ratings, to uniform density and texture.
- C. Install material at openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.
- D. Remove dam material after firestopping material has cured only if dam material is not required as part of the firestopping system; otherwise dam material to remain permanently in place.
- E. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- F. Install labeling required by code.

3.4 INSTALLATION - FIRE SAFING INSULATION

- A. Install safing insulation to completely fill spaces between floor slab edges and spandrel construction as detailed.
- B. Install safing insulation to completely fill voids between floor and roof deck flutes and top of wall construction where wall ratings are indicated.
- C. Install and support safing insulation permanently in position to comply with tested fire assembly and applicable building code requirements.

3.5 INSTALLATION - FIRESTOPPING PADS

- A. Install firestopping pads on back side of electrical junction boxes in fire-rated walls where boxes are located in same stud space on opposite sides of same wall, and elsewhere required by jurisdictional authority and local fire department.

3.6 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.7 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling gunnable and pourable joint sealants.
- C. Joint backings and accessories.

1.2 DEFINITIONS

- A. Nonsag Sealant: Permits application in joints on vertical surfaces without sagging or slumping.
- B. Self-leveling Sealant: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.

1.3 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
- G. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- H. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- I. SWRI - Sealant, Waterproofing and Restoration Institute; Sealants: The Professionals' Guide; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sealant work with other work requiring sealants, and with other Sections referencing this Section; do not obstruct indicated or required moisture weepage systems under any circumstances.
 - 2. Coordinate sealant surface preparation of exterior joint sealants scheduled for paint finish with Section 09 91 13. Provide advice and recommendations on compatibility of specified preparation procedures with sealants used.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

1.6 QUALITY ASSURANCE

- A. Conform to SWRI recommendations for materials and installation.

- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum three years documented experience.
 - C. System Compatibility: Assume responsibility for confirming that sealants are compatible with each other as a system, and also compatible with substrate surfaces with which they will be in contact, including but not limited to wall and sheathing surfaces, opening materials, other flashings and weather barrier materials.
 - 1. Assure that system components are compatible as specified prior to preparing and making specified submittals.
 - 2. Assume responsibility for removal of incompatible system components and installation of properly compatible components at no additional cost to Owner regardless of when incompatibility is discovered.
- 1.7 FIELD CONDITIONS
- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
 - 1. Install sealants only when temperature is in lower third of manufacturer's recommended installation temperature range wherever joint width is affected by ambient temperature variations.
 - 2. Install sealants only when ambient temperature conditions can be maintained at or above 40 degrees F (4 degrees C) during installation and 48 hours immediately following installation.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site in original, unopened containers or bundles with labels indicating manufacturer, product name and designation, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- 1.9 WARRANTY
- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
 - B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.
 - C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Dow Corning Corporation: www.dowcorning.com.
 - 2. Master Builders Solutions: www.master-builders-solutions.com/en-us/#sle.
 - 3. Momentive Performance Materials, Inc. (formerly GE Silicones): www.momentive.com.
 - 4. Pecora Corporation: www.pecora.com.
 - 5. Sika Corporation: www.usa.sika.com/#sle.
 - 6. Tremco Global Sealants: www.tremcosealants.com.
 - 7. W.R. Meadows, Inc.: www.wrmeadows.com.
 - 8. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 JOINT SEALANT APPLICATIONS

- A. Sealant Scope:
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
 - 1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
 - 2. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
 - 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 - 2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.

3. Floor Joints in Wet Areas: Self-leveling polyurethane "traffic-grade" sealant suitable for continuous liquid immersion.
 4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant.
 5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 6. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
 7. Under Exterior Wall Sill Plates: Pre-Formed Elastomeric Foam Seal (PF): Protectowrap Triple Guard energy Sill Sealer.
 - D. Definitions of Special Use Areas:
 1. Interior Wet Areas: Include bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, countertops, and cabinets.
 2. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.
- 2.3 JOINT SEALANTS - GENERAL
- A. Hardness: As recommended by manufacturer for applications shown.
 - B. Modulus of Elasticity: Provide lowest available modulus of elasticity for indicated requirements and consistent with exposure to weathering, indentation, abrasion and support of loading.
 - C. Compatibility: Provide sealants, joint fillers, and related materials that are compatible with one another and with substrates and other materials to which they will be exposed in the joint system.
 - D. Grade: For each application, provide grade of sealant complying with ASTM C920, and as recommended by manufacturer for indicated conditions, to achieve best possible performance. Types, grades, classes, and uses specified are for normal conditions.
 - E. Colors: As selected from manufacturer's full line, unless otherwise specified.
- 2.4 NONSAG JOINT SEALANTS
- A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661 or ASTM D2240.
 4. Color: Match adjacent finished surfaces.
 5. Cure Type: Single-component, neutral moisture curing.
 - B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Color: Clear.
 - C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661 or ASTM D2240.
 3. Color: Match adjacent finished surfaces.
 4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
 - D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
- 2.5 SELF-LEVELING JOINT SEALANTS
- A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
- 2.6 ACCESSORIES
- A. Sealant Backing Rod, Bi-Cellular Type:
 1. Cylindrical flexible sealant backings complying with ASTM C1330 Type B.
 2. Size: 25 to 50 percent larger in diameter than joint width.
 3. Products:

- a. Adfast USA Inc; Adseal BR-2600 Backer Rod: www.adfastcorp.com/#sle.
- b. Nomaco, Inc; SOF Rod: www.nomaco.com/#sle.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Multiple backer rods are not permitted; use single backer rod properly sized to joint width.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not obstruct indicated or required moisture weepage systems under any circumstances.
- H. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- I. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.4 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

3.5 SCHEDULE

- A. Exterior Joints for Which No Other Sealant Designation is Indicated: Designation Silicone-General-Purpose.
- B. Control and Expansion Joints in Paving: Designation Urethane-Self Levelling.
- C. Interior Wall Expansion Joints: Designation Urethane-Non-Sag.
- D. Exterior Wall Expansion Joints: Designation Silicone-General Purpose.
- E. Control, Expansion, and Soft Joints in Masonry, and Between Masonry and Adjacent Work: Designation Silicone-General Purpose.
- F. Lap Joints in Exterior Sheet Metal Work: Designation Silicone-General Purpose.

- G. Joints Between Exterior Metal Frames and Adjacent Work: Designation Silicone-General Purpose.
- H. Under Exterior Door Thresholds: Bituminous Mastic.
- I. Interior Joints for Which No Other Sealant is Indicated: Designation Acrylic Latex.
- J. Control and Expansion Joints in Interior Concrete Slabs and Floors: Designation Urethane-Self Levelling.
- K. Joints Between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Designation Silicone-Sanitary.
- L. In STC-Rated Walls, Between Metal Stud Track/Runner and Adjacent Construction: Designation Acrylic Latex.
- M. Between Slab on Grade and Exterior Wall Sill Plates: Designation Preformed. Refer to Section 061000.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hollow metal doors and frames, including:
 - 1. Non-fire-rated hollow metal doors and frames.
 - 2. Hollow metal frames for wood doors.
 - 3. Fire-rated hollow metal doors and frames.
 - 4. Thermally insulated hollow metal doors with frames.
 - 5. Hollow metal borrowed lites glazing frames.

1.2 DEFINITIONS

- A. NAAMM/HMMA: National Association of Architectural Metal Manufacturers; Hollow Metal Manufacturers Association.
- B. SDI: Steel Door Institute.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- H. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- J. ITS (DIR) - Directory of Listed Products; Current Edition.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- M. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- Q. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
- R. UL (DIR) - Online Certifications Directory; Current Edition.
- S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with wall construction for anchor placement.
 - 2. Coordinate installation of hardware.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
 - C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
 - D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
 - E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
 - B. Maintain at project site copies of reference standards relating to installation of products specified.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 - B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.
 - C. Inspect hollow metal products upon delivery for damage. Minor damage may be repaired provided refinishing is equal in all respects to new work and is acceptable to Architect; otherwise replace damaged items with new products as specified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Any listed member of SDI or NAAMM/HMMA in good standing; www.steeldoor.org or www.naamm.org/hmma, including the following:.
 - 2. Amweld Building Products, Inc.: www.amweld.com.
 - 3. Ceco Door, an ASSA ABLOY Group company: www.assaabloydss.com.
 - 4. Curries, an ASSA ABLOY Group company: www.assaabloydss.com.
 - 5. Fleming Door Products, an Assa Abloy Group company: www.assaabloydss.com.
 - 6. Republic Doors, an Allegion brand: www.republicdoor.com.
 - 7. Steelcraft, an Allegion brand: www.allegion.com.
 - 8. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 GENERAL DOOR AND FRAME REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M (for exterior doors and frames), cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Typical Door Face Sheets: Flush, unless otherwise indicated on Drawings.
 - 4. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 - a. Prepare doors and frames for hardware in accordance with templates provided under Section 08 71 00.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 - 2. Door Core Material: Vertical steel stiffeners with fiberglass batts.
 - 3. Door Thermal Resistance: Refer to Drawings.
 - 4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 - 5. Top Closures for Outswinging Doors: Flush with top of faces and edges.
 - 6. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire-Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
 - 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 - 3. Door Finish: Factory primed and field finished.
- C. Interior Doors, Fire-Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 - 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - b. Attach fire rating label to each fire rated unit.
 - 3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 - 4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 - 5. Door Finish: Factory primed and field finished.

2.4 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Exterior Door Frames: Full profile/continuously welded type.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvanized) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
 - 2. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
 - 3. Frame Finish: Factory primed and field finished.
 - 4. Weatherstripping: Separate, see Section 08 71 00.
- C. Interior Door Frames, Non-Fire Rated: Face welded type.
 - 1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 - 2. Frame Finish: Factory primed and field finished.
- D. Interior Door Frames, Fire-Rated: Face welded type.
 - 1. Fire Rating: Same as door, labeled.
 - 2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 - 3. Frame Finish: Factory primed and field finished.

HOLLOW METAL DOORS AND FRAMES

- E. Frames for Wood Doors: Comply with general interior metal frame requirements in accordance with corresponding wood door; minimum 18 gauge thickness, unless otherwise indicated.
 - 1. Special Features: Include knock-down style and handicap accessible features.
 - F. Borrowed Lites Glazing Frames: Construction and face dimensions to match typical interior metal door frames, and as indicated on Drawings; minimum 18 gauge thickness, unless otherwise indicated.
- 2.5 FINISHES
- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- 2.6 ACCESSORIES
- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
 - B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

- 3.1 EXAMINATION
- A. Verify existing conditions before starting work.
 - B. Verify that opening sizes and tolerances are acceptable.
 - C. Verify that finished walls are in plane to ensure proper door alignment.
- 3.2 INSTALLATION
- A. Install doors and frames in accordance with manufacturer's instructions, regulatory requirements, and related requirements of specified door and frame standards or custom guidelines indicated.
 - 1. Install fire rated units in accordance with NFPA 80.
 - B. Install door hardware as specified in Section 08 71 00.
- 3.3 TOLERANCES
- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
 - B. Maximum Diagonal Distortion (Warp): 1/8 in (3.0 mm)ch measured with straight edge, corner to corner.
- 3.4 ADJUSTING
- A. Adjust for smooth and balanced door movement.
- 3.5 SCHEDULE
- A. Refer to Door and Frame Schedule on Drawings.

END OF SECTION

SECTION 08 11 13.15 - KNOCK-DOWN STEEL DOOR FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Prefinished steel frames for interior doors.

1.2 SUBMITTALS

- A. Product Data: For specified products. Include details of design and construction and printed instructions covering installation.
- B. Shop Drawings: Show layout, profiles and product components, including anchorage, accessories, finish colors and textures. Indicate installation requirements of finish hardware and reinforcements.
- C. Samples: For selection and verification of finishes, colors and textures.
 - 1. Sample of door frame corner construction, complete with snap-on casings.
 - 2. Samples of factory stocked colors of prefinished components.
 - 3. Samples of custom colors for color matching.
- D. Quality Assurance Submittals:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - 2. Certificates: Manufacturer's certification that installer is acceptable.
 - 3. Warranty: Submit the warranty documents specified.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.
 - 1. Personnel: Assembly and installation shall be performed by qualified personnel who have successfully completed manufacturer's prefinished steel door frame installation course online and have been approved by the manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 01 Product Requirements Sections.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Factory package components in protective cartons to prevent damage during shipping.
- C. Storage and Protection: Store materials protected from exposure to harmful weather and at temperature conditions recommended by manufacturer.
 - 1. Store material on wooden skids under cover in a protected area and keep vented to avoid condensation until ready for installation.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress schedule to avoid construction delays.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Passes positive pressure test in accordance with UL 10C.

2.2 PREFINISHED STEEL DOOR FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Timely Prefinished Steel Door Frames.
- B. Substitutions: Submit in accordance with Section 01 25 00 "Substitution Procedures."

2.3 MATERIALS

- A. Header and Jamb Members: Form interior door frames of ASTM A366 commercial quality cold rolled steel. Form exterior door frames of galvanized steel (A40) per ASTM A653. Provide frames in the following gages:
 - 1. 1 3/8 Inch (35 mm) or 1 3/4 Inch (44 mm) Door Frames: 18 gage.
 - 2. 1 3/4 Inch (44 mm) Door Sidelite Frames: 18 gage.
 - 3. Borrowed Lite Frames: 18 gage.
- B. Casings:
 - 1. Steel: 22 gage cold rolled steel to ASTM A366.
 - 2. Aluminum: 0.050 inch (1.3 mm) aluminum extrusion 6063-T5 alloy.
 - 3. Style: 1-1/2-inch wide flat.
- C. Hinge Reinforcements: 14 gage hot dipped galvanized (G60) steel to ASTM A653 (10 gage equivalent number of threads, SDI-107).
- D. Strikes and Deadbolt Covers and Dust Box: 18 gage commercial quality cold rolled steel to ASTM A366.
- E. Door Closer Reinforcement: Steel or aluminum in accordance with manufacturer's standard.
 - 1. Standard Arm Mounting: Aluminum extrusion 6063-T5 alloy in accordance with manufacturer's standard.
 - a. Door Guard: Aluminum extrusion 6063-T5 alloy in accordance with manufacturer's standard.
 - 2. Parallel Arm Mounting: 16 gage galvanized (A40) steel per ASTM A653.
- F. Casing Corner Alignment Clips: Pre-painted 22 gage ASTM A366 commercial quality cold rolled steel.
- G. Felt Silencers and Weatherstripping (Standard Profile): In accordance with manufacturer's standard.
 - 1. Interior Frames: Install felt silencers on the header and strike jamb. Single door opening, 3 per strike jamb. Pair door opening, 2 per header.
- H. Removable Glazing Bead for Sidelite and Borrowed Lite Frames:
 - 1. 18 gage galvanized (A60) steel to ASTM A653, 3/4 inch x 5/8 inch (19.1 x 15.9 mm).
 - 2. Pre-punched for #6 x 1 1/4 inch (32 mm) bugle-head self-tapping screws.
- I. Fasteners: In accordance with manufacturer's standards
 - 1. Fastener shall be a minimum of 1/2 inch (12.7 mm) longer than combined thickness of drywall.
 - a. Fastener: 1 1/4 inch (32 mm) minimum Type "S" bugle-head self-tapping screws.
 - b. Fastener: 1 1/4 inch (32 mm) minimum drywall screws (coarse thread).
- J. Paint: Frame manufacturer's standard baked-on synthetic enamel, applied over a cleaned and phosphate coated surface.
 - 1. Application shall be by electrostatic method.
 - 2. Finish paint dry film thickness on doors panels shall be approximately 1 mil (0.03 mm) for finished paint.
 - 3. Factory finish paint shall pass 200 hour salt spray test in accordance with ASTM B117 and 700 hour humidity test in accordance with ASTM D1735 with no blistering.
 - 4. Paint hardness shall meet calibrated pencil lead test to ASTM D3363.
 - 5. Prime painted frames shall be field painted within 30 days of installation with a good quality oil based enamel as recommended, or a high quality water base latex. A flash rust inhibitor shall be used with water base latex method.

2.4 MANUFACTURED UNITS

- A. General: Frames shall be prefinished type designed for installation at rough wall openings over prefinished walls.
 - 1. Provide steel frames to receive metal casings to conceal fasteners.
 - 2. Prepare steel frames to receive decorative wood moldings to conceal fasteners.
 - 3. Provide accessories and fasteners necessary for field assembly and installation in accordance with frame manufacturer's standards.
 - 4. Prepare for and provide reinforcements in accordance with manufacturer's standards as required to receive finished hardware.
- B. Door Frames:
 - 1. Construct jamb member to interlock and align with header members to form a strong joint.
 - 2. Provide die cut mitered metal casings held tight together and in alignment with concealed corner backing pieces. Casings shall conceal all frame fasteners. Provide concealed clips to receive snap-on casings.

- C. Sidelite and Borrowed Lite Frames:
 - 1. Construct same as specified for door frames. Where required, provide concealed field applied mullion clips for securing mullions to head/jamb members.
 - 2. Form fixed glazing stops integral with frame members. Provide removable metal stops with pre-punched screw holes complete with installation screws.
- D. Hardware Preparations:
 - 1. In accordance with an approved Hardware Schedule, ANSI A115 and manufacturer's recommendations:
 - a. Mortise frames for hinges and strikes.
 - b. Drill and tap or reinforce frames for mortised or surface mounted hardware.

2.5 FINISHES

- A. Frames, Sidelite and Borrowed Lites Finish:
 - 1. Color: As selected by Architect from Manufacturer's full range.

2.6 SOURCE QUALITY CONTROL

- A. Obtain steel door frame products from a single manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify that conditions of substrates previously installed under other sections are acceptable for product installation in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Prefinished Steel Door Frames:
 - 1. Install frames plumb and square, in accordance with shop drawings and manufacturer's instructions. Verify opening and dimensions with shop drawings. Use door as a template to ensure proper alignment and clearances.
 - 2. Attach hinges and hang door in frame. Adjust frame to door for equal and uniform clearance between top and sides of door and frame.
 - 3. Secure frame to wall with the appropriate type fasteners. Install casing on frame.
 - 4. Adjust strike plate to hold door tight to stops when closed.

3.4 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

3.5 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction.
 - 1. Repair or replace damaged or defective frames.
 - 2. Touch up damaged areas of factory-applied finishes with aerosol spray cans of same paint as used in factory.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors, including:
 - 1. Interior wood doors; fire-rated and non-rated types.

1.2 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- D. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with door opening construction, door frame and door hardware installation.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit accepted manufacturer's stain color selector guide.
 - 1. After initial color selection, submit two samples 12 x 12 inch in size illustrating selected stain color, face veneers, and specified finishes.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with not less than three years of documented experience.
- B. Obtain all doors of each type specified from a single manufacturer to assure uniformity of appearance and construction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Algoma Hardwoods, Inc.: www.algomahardwoods.com.
 - 2. Haley Brothers: www.haleybros.com/#sle.
 - 3. Masonite Architectural: www.architectural.masonite.com/#sle.
 - 4. Oregon Door: www.oregondoor.com/#sle.
 - 5. VT Industries, Inc.: www.vtindustries.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DOORS

- A. Doors: Refer to Drawings for locations and additional requirements.

1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at each location.
 2. Provide following types at locations as scheduled on Drawings:
 - a. Wood veneer facing with factory transparent finish.
 - b. Wood veneer facing for field opaque finish.
- 2.3 DOOR AND PANEL CORES
 - A. General Requirement: Provide door cores fully bonded to stiles and rails.
 - B. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
 - C. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- 2.4 DOOR FACINGS
 - A. Veneer Facing for Transparent Finish: Species as selected by Architect, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with slip match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
 1. Vertical Edges: Same species as face veneer, solid wood edges, minimum 0.25 inch thick.
 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet (3 m) of each other when doors are closed.
 - B. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.
 - C. Facing Adhesive: Type I - waterproof.
- 2.5 DOOR CONSTRUCTION
 - A. Fabricate doors in accordance with door quality standard specified.
 - B. Cores constructed with stiles and rails:
 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
 - a. Provide solid blocking for other throughbolted hardware.
 2. Provide minimum 6 inch high solid wood top rail and minimum 16 inch high solid wood bottom rail, all doors; fire-resistant treated at fire-rated doors.
 - C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
 - D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
 1. Exception: Doors to be field finished.
 - E. Provide edge clearances in accordance with the quality standard specified.
- 2.6 FACTORY FINISHING - WOOD VENEER DOORS
 - A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 1. Transparent:
 - a. System - 11, Polyurethane, Catalyzed.
 - b. Sheen: Satin.
 2. Opaque:
 - a. System - 2, Lacquer, Precatalyzed.
 - b. Color: As selected by Architect.
 - c. Sheen: Satin.
 - B. Factory finish doors in accordance with approved sample.

2.7 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 11 13.
- B. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions, regulatory requirements, and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Adjust width of non-rated doors by cutting equally on both jamb edges.
 - 1. Trim maximum of 3/4 inch (19 mm) off bottom edges.
 - 2. Trim fire-rated doors in strict compliance with fire rating limitations.
- D. Use machine tools to cut or drill for hardware.
- E. Install door louvers plumb and level.

3.3 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.
- C. Maximum Undercut at Fire-Rated Doors: 3/4 inch (75 mm) clearance to non-combustible finish floor surface.

3.4 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.
- C. Restore finish on all edges of shop finished doors before installation, if fitting or machining is required on site.

3.5 SCHEDULE

- A. Refer to Door and Frame Schedule on the Drawings.

END OF SECTION

SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall- and ceiling-mounted access units.
- B. Attic access hatches.

1.2 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- C. ITS (DIR) - Directory of Listed Products; Current Edition.
- D. UL (FRD) - Fire Resistance Directory; Current Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate installation with work of other trades, and obtain information on door sizes and exact locations from other trades.
 - 2. Coordinate placement of rough-in openings with Architect in tiled walls and gypsum board ceilings.
 - 3. Coordinate placement of access doors and panels with locations of toilet partitions and urinal screens so that doors or panels are not placed in conflict with partition or screen locations.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

1.5 QUALITY ASSURANCE

- A. Basis of Design: Specifications are based on access door types and model numbers by the specified basis of design manufacturer. Access door types manufactured by other acceptable manufacturers are permitted, subject to compliance with specified requirements; and provided that deviations in dimensions and profile are minor, and do not detract substantially from the indicated design intent.
 - 1. Comply with requirements specified in Section 01 40 00 and Section 01 60 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
 - 2. ACUDOR Products Inc.: www.acudor.com.
 - 3. Babcock-Davis: www.babcockdavis.com.
 - 4. Karp Associates, Inc.: www.karpinc.com.
 - 5. Milcor by Commercial Products Group of Hart & Cooley, Inc.: www.milcorinc.com.
 - 6. Nystrom, Inc.: www.nystrom.com.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 ACCESS DOOR AND PANEL ASSEMBLIES

- A. Walls in Wet Areas:
 - 1. Panel Material: Stainless steel, Type 304.
 - 2. Size: Refer to Schedule below.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. In All Wall Types: Surface mounted face frame and door surface flush with frame surface; gasketed door to frame all 4 sides.

5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
 6. Masonry and Tile Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.
 - B. Fire Rated Walls: See Drawings for wall fire ratings.
 1. Panel Material: Steel; prime painted.
 2. Size: Refer to schedule below.
 3. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
 - C. Ceilings, Unless Otherwise Indicated: Same type as for walls in corresponding functional locations.
- 2.3 WALL- AND CEILING-MOUNTED ACCESS UNITS
- A. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 1. Door Style: Single thickness with rolled or turned in edges.
 2. Frames: 16-gauge, 0.0598-inch (1.52 mm) minimum thickness.
 3. Single Steel Sheet Door Panels: 16-gauge, 0.0625-inch (1.6 mm) minimum thickness.
 4. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 5. Steel Finish: Primed.
 6. Stainless Steel Finish: No.4 brushed finish.
 7. Hardware:
 - a. Hinge for Fire-Rated-Units: 175 degree steel hinges with non-removable pin.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Latch/Lock: Tamperproof tool-operated cam latch.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
 - e. Gasketing: Extruded neoprene, around perimeter of door panel.
- 2.4 ATTIC ACCESS HATCHES - CEILING UNITS
- A. Basis of Design Manufacturer:
 1. Bessler Stairway Co., a division of American Stairways, Inc.; Model BE-119: www.besslerstairway.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
 - B. Ceiling Hatch with Ladder: Steel construction; flush panel, counterbalanced, open downward; 30 x 48 inch nominal door size.
 1. Fire Resistance: 1 hour in accordance with ASTM E119.
 2. Furnish assemblies with manufacturer's standard construction, with details, and anchorage as appropriate to indicated substrates.
 3. Size: 25-1/2 inches wide by 54 inches, rough opening.
 4. Loading: Maximum 350 lbs.
 5. Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - a. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices.
 - b. Steel Finish: Powder coat; color to be selected by Architect from manufacturer's standard range.
 - c. Wood Finish: Manufacturer's standard.
 6. Lock: Dead bolt lock; provide two keys.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Review access panel locations during wall framing rough-in to confirm location is coordinated with interior wall finishes.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.
- D. Adjust hardware and panels for proper operation.
- E. Wet Locations: Seal frame to host wall all around; clear silicone sealant as specified in Section 07 92 00.

3.4 SCHEDULE

- A. Provide access doors where indicated and in the following locations:
 - 1. Access required by code.
 - 2. Access required for servicing operable, adjustable, or resettable fire suppression, plumbing, mechanical, electrical, life safety, security, and communication systems.
- B. Sizes: Provide the following unless noted otherwise:
 - 1. Ceilings and Soffits: 24 inches by 24 inches minimum.
 - 2. Toilet Rooms: 12 inches by 12 inches minimum at each fixture chase wall.
- C. Materials:
 - 1. Uncoated steel sheet unless noted otherwise.
 - 2. Stainless Steel:
 - a. Toilet rooms, locker rooms, and food service areas,.
 - b. Walls scheduled to receive tile finish, epoxy paint, or FRP panels.

END OF SECTION

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront framing system.
- B. Aluminum doors and frames.
 - 1. Weatherstripping.
- C. Design engineering of framing system and load-bearing connections to building structural frame system.

1.2 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- E. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- G. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- H. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022, with Errata (2023).
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- M. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007 (Reapproved 2018).
- N. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- O. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- P. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- Q. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
- R. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate attachment and seal of perimeter air and vapor barrier materials.
 - 2. Coordinate with installation of other components that comprise the exterior enclosure.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit two samples 12 inches (300x300 mm) long illustrating finished aluminum surface.
- E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.
- C. Basis of Design: Drawing details are based on framing profiles by specified basis of design manufacturer. Similar framing profiles by other acceptable manufacturers are permitted, subject to compliance with all specified performance characteristics, and provided that deviations in dimension, profile, and finish are minor, and do not detract from the indicated design intent.
 - 1. Comply with requirements specified in Section 01 40 00 and Section 01 60 00.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store products of this Section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer:
 - 1. Kawneer North America.: www.kawneer.com.
 - a. Frame Series: TriFab VG 451T for exterior applications and TriFab 450 for interior applications.
 - b. Door Style: 350 Medium Stile or other stile width as indicated on the Drawings; thermally broken at exterior locations.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Other Acceptable Manufacturers:
 - 1. Arcadia, Inc.: www.arcadiainc.com.
 - 2. EFCO Corporation: www.efcocorp.com.
 - 3. Oldcastle BuildingEnvelope: www.oldcastlebe.com.
 - 4. Tubelite, Inc.: www.tubeliteinc.com.
 - 5. YKK AP America, Inc: www.ykkap.com/commercial.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 ALUMINUM-FRAMED STOREFRONT SYSTEM

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing, unless otherwise indicated for interior applications.
 2. Glazing Position: Centered (front to back) unless otherwise indicated on Drawings.
 3. Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep) for exterior applications.
 4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - a. Fabricate individual system frame members, comp heads, sill pans, and other system components in single, continuous pieces; splices are not permitted unless specifically required by project installation conditions.
 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 10. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.

2.3 PERFORMANCE REQUIREMENTS

- A. Design Requirements: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
1. Design Wind Loads: Comply with requirements of applicable code.
 2. Member Deflection: Limit member deflection to L/175 of clear span, 3/4 inch total, or to flexure limit of glass in any direction, whichever is less, with full recovery of glazing materials.
 3. Provide reinforced mullion sections as may be required to comply with specified design requirements, for manufacturer's specified system.
- B. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf (390 Pa).
- C. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 6.27 psf (300 Pa) 6.27 psf (300 Pa) pressure difference.
- D. Thermal Performance Requirements:
1. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503.
 2. Overall U-factor Including Glazing: Maximum values (or as otherwise required to meet applicable energy code).
 - a. Fixed Glazing: 0.38 or as otherwise required to meet building code.
 - b. Entrance Doors: 0.77 or as otherwise required to meet building code.

2.4 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior at exterior applications, drainage holes and internal weep drainage system.

1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
 3. Corner and Closure Assemblies: Fabricated from manufacturer's standard aluminum sheet of minimum thickness required for indicated span conditions; warping and oil-canning appearance not permitted.
 - a. 90-Degree Corners: Manufacturer's standard combination of two pocket corner extrusions.
 - b. Corners Other Than 90 Degrees: Manufacturer's standard varying degree pocket corner extrusions with aluminum sheet metal fillers and closures.
 4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 - a. As required or recommended by manufacturer for indicated loading requirements using manufacturer's standard profile of extruded aluminum with internal reinforcement of steel shaped structural section.
- B. Glazing: See Section 08 80 00.
- C. Swing Doors: Glazed aluminum; nominal stile and rail dimensions as follows:
1. Thickness: 1-3/4 inches (43 mm).
 2. Top Rail: 3-1/2 inches (88 mm) wide.
 3. Vertical Stiles: 3-1/2 inches (88 mm) wide.
 4. Bottom Rail: 10 inches (254 mm) wide.
 5. Glazing Stops: Square.
 6. Finish: Same as storefront.
 7. Design exterior doors for one inch insulating glass units and thermally broken, and interior doors for 1/4 inch glass and non-thermally broken.
- D. Exterior Mullion Caps: Manufacturer's standard extrusions designed for installation on exterior mullions; sizes, shapes, and configurations as indicated on Drawings.

2.5 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M); minimum thicknesses as follows:
1. Corner and Closure Assemblies: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
 2. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
 3. Concealed Flashings: Sheet aluminum, 26 gauge, 0.017 inch (0.43 mm) minimum thickness.
- C. Fasteners: Stainless steel.
- D. Sill Pan Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- E. Glazing Gaskets: As recommended by storefront manufacturer; type to suit application to achieve weather, moisture, and air infiltration requirements.
1. Size gaskets as required by manufacturer of glazing channel frame to provide proper pressure and bite on glazing units.
 2. Coordinate with glazing requirements specified in Section 08 80 00 - Glazing.
- F. Glazing Accessories: See Section 08 80 00.

2.6 ACCESSORIES

- A. Reinforcement: Where fasteners screw-anchor into aluminum less than 1/8 inch thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive, pressed-in splined grommet nuts.
- B. Brackets: High-strength aluminum brackets and reinforcements where possible; otherwise provide non-magnetic stainless steel or galvanized steel complying with ASTM A123/A123M.
- C. Sill Pans: Manufacturer's standard extruded profile, thermally broken, designed to direct moisture to the exterior at sill conditions; including splice sleeves and continuously sealed end dams.
- D. Comp-Heads: Manufacturer's standard extruded profile, thermally broken, designed to accommodate minimum one inch deflection of building elements at head conditions.

- E. Water Deflectors: Manufacturer's standard internal system accessory specifically designed to route internal water drainage away from top surfaces of insulated glass units.
- F. Expansion Anchors: Stainless steel, drilled-in type expansion bolts for required attachment to concrete or masonry.
- G. Protective Backing Paint: Asphaltic mastic, ASTM D4479/D4479M, Type I.
- H. Internal System Sealants and Gaskets: As recommended by manufacturer for use within the framing system for fabrication, assembly, and installation. Use products which will remain permanently elastic, non-shrinking, and waterproof.

2.7 FINISHES (PROVIDE ONE OF THE FOLLOWING AS SELECTED BY THE ARCHITECT)

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- C. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch (0.030 mm).
- D. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.8 HARDWARE

- A. For each door, include weatherstripping and sill sweep strip by door manufacturer.
- B. Other Door Hardware: See Section 08 71 00.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of silicone or EPDM; provide on all doors.
- E. Reinforce components internally for door hardware and door operators.
- F. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies, including exposed fasteners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this Section.

3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- G. Install comp-head units where detailed; do not secure comp-heads to primary storefront head frames.
- H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

- C. Location: Limit variation from plane or dimensioned location to 1/8 inch in 12 feet, non-cumulative, and 1/2 inch in overall length of member.

3.4 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as directed by Architect.
 - 2. Test Frequency: Minimum 75 square feet for every 10,000 square feet of installed glazing.
 - 3. Conduct tests in each area prior to 50 percent completion of this work.
 - 4. Successful Test Result: No water leakage.
- D. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.5 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 53 13 - VINYL WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vinyl-framed, factory-glazed windows [and sliding glass doors].
- B. Operating hardware.
- C. Insect screens.
- D. Design engineering of windows to comply with requirements specified in this Section.

1.2 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022, with Errata (2023).
- B. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products; 2021.
- C. AAMA 701/702 - Performance Specification for Pile Weatherstrips (AAMA 701) and Polymer Weatherseals (AAMA 702); 2023.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- E. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- F. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- J. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
- K. ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation; 2022.
- L. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2023.
- M. ASTM F588 - Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact; 2017 (Reapproved 2023).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate attachment and seal of perimeter air and vapor barrier materials.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, anchors, fasteners, glass, and internal drainage.
- C. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work, and installation requirements.
- D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
 - 1. Evidence of AAMA Certification.
 - 2. Evidence of WDMA Certification.
 - 3. Evidence of CSA Certification.
 - 4. Evidence of NFRC Certification.
 - 5. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- E. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

- F. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.
- C. Basis of Design: Drawings are based on specific window types and model numbers by the specified basis of design manufacturer. Window types manufactured by other acceptable manufacturers are permitted, subject to compliance with all performance requirements; and provided that deviations in dimensions and profile are minor, and do not detract substantially from the indicated design intent.
 - 1. Comply with requirements specified in Section 01 40 00 and Section 01 60 00.

1.6 MOCK-UP

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Mock-up: Provide single window unit mock-up, illustrating typical installation including all flashings and sealants.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- B. Jig, brace, and box the window frame assemblies for transport to minimize flexing of members or joints.

1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).
- B. Maintain this minimum temperature during and after installation of sealants.

1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a 5-year period after Date of Substantial Completion.
- C. Manufacturer's Warranty: Provide 10 manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for degradation of vinyl color finish. Complete form in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Jeld-Wen, Inc.: www.jeld-wen.com.
 - 2. Milgard Manufacturing, Inc.: www.milgard.com.
 - 3. Pella Corporation: www.pellacommercial.com.
 - 4. Prime Window Systems, LLC: www.primewindowsys.com.
 - 5. Thermal Windows; www.thermalwindows.com
 - 6. Quaker Window Products Company: www.quakercommercialwindows.com.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 VINYL WINDOW UNITS

2.3 PERFORMANCE REQUIREMENTS

- A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
 - 1. Performance Class (PC): LC.
 - 2. Performance Grade (PG): 25, with minimum design pressure (DP) of 25.06 psf (1200 Pa).
- B. Condensation Resistance Factor: CRF of 50, minimum, the lower value of the glass and frame window components and determined in accordance with AAMA 1503.

- C. Air Leakage: 0.3 cfm/sq ft (1.5 L/sec sq m) maximum leakage of window when tested at 1.57 psf (75 Pa) pressure difference in accordance with ASTM E283/E283M.
- D. Water Leakage: None, when measured in accordance with ASTM E331.
- E. Forced Entry Resistance (FER): Tested to comply with ASTM F588 requirements having at least Grade 10 performance for each required window assembly.
- F. Acoustic Performance: Minimum outdoor-indoor transmission class (OITC) rating of 27, when tested in accordance with ASTM E90 and ASTM E1332.
- G. Provide windows and doors with U value, SHGC, and SC values as required to meet energy code requirements.

2.4 COMPONENTS

- A. Glazing: Insulated double pane, annealed glass, clear, low-E coated, argon filled, with glass thicknesses as recommended by manufacturer for specified wind conditions and acoustic rating indicated.
 - 1. Glass Stops: Snap-on PVC glazing bead with color to match sash and frame.
 - 2. Glazing Tape: Closed cell foam type with double sided adhesive.
 - 3. Setting Blocks: Manufacturer's standard.
 - 4. Provide fully tempered glass where required to meet code for impact resistance.
 - 5. Pane Thickness: Determined by pane size and loading requirements.
 - 6. Durability: Certified by an independent testing agency to comply with ASTM E2190.
- B. Frame Depth: Manufacturer's standard.
- C. Operable Sash Weatherstripping: Resilient PVC; permanently resilient, profiled to maintain weather seal in accordance with AAMA 701/702.
- D. Fasteners: Galvanized steel.
- E. Accessories: Provide related flashings, anchorage and attachment devices as necessary for full assembly.
- F. Flashing Tape: Flexible adhesive tape designed specifically for use at window nailing flanges to seal window unit to substrate; product specified for weather barrier and sheathing materials as specified in Section 07 25 13.

2.5 HARDWARE

- A. General: Comply with applicable ADA Standards for opening force and accessible reach range in windows in accessible (Type A) living units. See section 087650 - Assistive Window Actuators.
- B. Fall Protection (for windows above the ground floor level): Opening of all windows beyond 4 inches must require 2 simultaneous motions. Opening control devices must meet requirements of ASTM F2090.
- C. Finish of Exposed Hardware: Baked enamel, match interior sash and frame color.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify wall openings and adjoining water-resistive barrier seal materials are ready to receive this work.

3.2 INSTALLATION

- A. Install window unit assemblies in accordance with manufacturers instructions and applicable building codes.
 - 1. Install windows in accordance with ASTM E2112.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities as necessary.
- C. Align window plumb and level, free of warp or twist, and maintain dimensional tolerances and alignment with adjacent work.
- D. Set sill members and sill flashing in continuous bead of sealant.
- E. For windows with nailing flanges, install window units on outer face of building wall sheathing, over sheathing membrane and associated flashings, or as specifically detailed on Drawings.
 - 1. Set nailing flanges in full and continuous bed of sealant at head and jambs only of window unit; intermittent sealant only at sill flange.

2. Install manufacturer's specified weatherstripping tape or adhesively applied flashings continuously over entire length of nailing flanges at head and jams; omit tape at sill locations; tape strips properly shingled to shed moisture in conjunction with weather barriers specified in other Sections.
- F. Install operating hardware.
- 3.3 TOLERANCES
 - A. Maximum Variation from Level or Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 0.5 inches per 100 ft (12 mm/30 m), whichever is less.
- 3.4 FIELD QUALITY CONTROL
 - A. See Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
 - B. Provide field testing of installed vinyl windows by AAMA accredited independent laboratory in accordance with AAMA 502 and AAMA/WDMA/CSA 101/I.S.2/A440 during construction process and before installation of interior finishes.
 1. Perform tests on three individual windows in designated locations as directed by Architect.
 2. Field test for water penetration in accordance with ASTM E1105 using Procedure B - cyclic static air pressure difference; test pressure shall not be less than 1.9 psf (91 Pa).
 3. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 6.24 psi (43034 Pa).
 - a. Maximum allowable rate of air leakage is 1.5 times specified rate of 0.10 cfm/sq ft (0.5 L/s sq m) as indicated in AAMA/WDMA/CSA 101/I.S.2/A440.
- 3.5 ADJUSTING
 - A. Adjust hardware for smooth operation and secure weathertight closure.
- 3.6 CLEANING
 - A. Remove protective material from pre-finished surfaces.
 - B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
 - C. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer and appropriate for application indicated.

END OF SECTION

SECTION 08 71 00

Door Hardware

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1. Section includes:
 1. Mechanical and electrified door hardware for:
 1. Swinging doors.
 2. Sliding doors.
 3. Gates.
 2. Electronic access control system components, including:
 1. Biometric access control reader.
 2. Electronic access control devices.
 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
 4. Lead-lining door hardware items required for radiation protection at door openings.
2. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
 1. Windows
 2. Cabinets (casework), including locks in cabinets
 3. Signage
 4. Toilet accessories
 5. Overhead doors
3. Related Sections:
 1. Division 01 Section "Alternates" for alternates affecting this section.
 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.

4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

1. UL - Underwriters Laboratories
 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
2. DHI - Door and Hardware Institute
 1. Sequence and Format for the Hardware Schedule
 2. Recommended Locations for Builders Hardware
 3. Key Systems and Nomenclature
3. ANSI - American National Standards Institute
 1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.4 SUBMITTALS

1. General:
 1. Submit in accordance with Conditions of Contract and Division 01 requirements.
 2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
 3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
2. Action Submittals:
 1. Product Data: Product data including manufacturers' 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:
 1. 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 or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
1. Samples will be returned to supplier in like-new condition. 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: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
1. Door Index; include door number, heading number, and Architects hardware set number.
 2. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 3. Type, style, function, size, and finish of each hardware item.
 4. Name and manufacturer of each item.
 5. Fastenings and other pertinent information.
 6. Location of each hardware set cross-referenced to indications on Drawings.
 7. Explanation of all abbreviations, symbols, and codes contained in schedule.
 8. Mounting locations for hardware.
 9. Door and frame sizes and materials.
 10. Name and phone number for local manufacturer's representative for each product.
 11. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
- 1) Submittal Sequence: Submit door hardware schedule 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 that is critical in Project construction schedule.
5. Key Schedule:

1. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used, and door numbers controlled.
2. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
3. 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.
4. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
5. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
6. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.
3. Informational Submittals:
 1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
 2. Product Certificates for electrified door hardware, signed by manufacturer:
 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 3. Certificates of Compliance:
 1. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 2. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 3. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
 4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
 5. Warranty: Special warranty specified in this Section.
4. Closeout Submittals:

1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
 1. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 2. Catalog pages for each product.
 3. Name, address, and phone number of local representative for each manufacturer.
 4. Parts list for each product.
 5. Final approved hardware schedule, edited to reflect conditions as-installed.
 6. Final keying schedule
 7. Copies of floor plans with keying nomenclature
 8. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 9. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

1. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
 1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 1. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
 2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
2. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.

1. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
3. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
4. Architectural Hardware Consultant Qualifications: 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:
 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 2. Can provide installation and technical data to Architect and other related subcontractors.
 3. Can inspect and verify components are in working order upon completion of installation.
 4. Capable of producing wiring diagrams.
 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
5. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
6. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, 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.
7. 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.
 1. Air Leakage Rate: 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.
8. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
9. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
10. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
 2. Maximum opening-force requirements:
 1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 2. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 3. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
11. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Owner, Contractor, Architect, Installer, Owner's security consultant, and Supplier's Architectural Hardware Consultant.
 2. 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 key control system.
 4. Requirements for access control.
 5. Address for delivery of keys.
12. Pre-installation 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. Inspect and discuss preparatory work performed by other trades.
 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.
13. Coordination Conferences:
1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.

1. Attendees: Door hardware supplier, door hardware installer, Contractor.
2. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 1. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Owner's security consultant, Architect and Contractor.
 2. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

1. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
2. 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.
 1. Deliver each article of hardware in manufacturer's original packaging.
3. Project Conditions:
 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
4. Protection and Damage:
 1. Promptly replace products damaged during shipping.
 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
5. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
6. Deliver keys to Owner by registered mail or overnight package service.

1.7 COORDINATION

1. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

2. Installation Templates: Distribute for doors, frames, and other work specified to be factory 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.
3. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
4. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
5. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
6. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
 1. Closers:
 - 1) Mechanical: 30 years.
 2. Automatic Operators: 2 year.
 3. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 4. Locksets:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 5. Key Blanks: Lifetime
 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

1. Maintenance Tools:
 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure 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.
2. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
3. 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.
4. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
5. 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.

2.2 MATERIALS

1. Fasteners
 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) 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 for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 4. Install hardware with fasteners provided by hardware manufacturer.
2. 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.
3. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
 1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.

2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. 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.

2.3 HINGES

1. Manufacturers and Products:
 1. Scheduled Manufacturer and Product: Ives 5BB series
 2. Acceptable Manufacturers and Products: Hager, ABH, McKinney
2. Requirements:
 1. Provide five-knuckle, ball bearing hinges conforming to ANSI/BHMA A156.1.
 2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 1. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 2. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
 3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 1. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 2. Interior: Heavy weight, steel, 5 inches (127 mm) high
 4. 2 inches or thicker doors:
 1. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 2. Interior: Heavy weight, steel, 5 inches (127 mm) high
 5. 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.
 6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
 7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 1. Steel Hinges: Steel pins
 2. Non-Ferrous Hinges: Stainless steel pins

3. Out-Swinging Exterior Doors: Non-removable pins
4. Out-Swinging Interior Lockable Doors: Non-removable pins
5. Interior Non-lockable Doors: Non-rising pins
8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
11. Provide mortar guard for each electrified hinge specified.
12. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.
13. Provide continuous hinges where specified.

2.4 Mortise LOCKS – GRADE 1

1. Manufacturers and Products:
 1. Scheduled Manufacturer and Product: Schlage L-series.
 2. Acceptable Manufacturers and Products: Falcon
2. Requirements:
 1. Provide Mortise locks conforming to the following standards and requirements:
 1. ANSI/BHMA, Grade 1.
 2. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
 3. Florida Building Code (ASTM E330, E1886, E1996) and Miami Dade (TAS 201, 202, 203) requirements for hurricanes.
 2. Cylinders: Refer to "KEYING" article, herein.
 3. Provide locks with standard latch throw. Provide proper latch throw for UL listing at pairs.
 4. Provide independently operating levers with two external return spring cassettes to prevent lever sag.
 5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

6. Provide electrified options as scheduled in the hardware sets.

2.5 Exit Devices

Low profile push bar exit devices

1. Manufacturers and Products:
 1. Scheduled Manufacturer and Product: VON Duprin 33/99 series.
 2. Acceptable Manufacturers: Falcon.
2. The maximum exit device projection shall be a maximum of 3-1/16" when activated. The exit device bar shall have an average minimum thickness of .201". The push pad surface shall be constructed of stainless steel; push pads with plastic or Lexan coatings shall not be acceptable. Nylon bearings and stainless steel springs shall be used for long life and durability. Only torsion or compression springs are acceptable. Extension type springs are not acceptable. All device covers shall be of cast brass, deep drawn steel or stainless steel. Latchbolts shall be of stainless steel and shall have a deadlocking latch for extra security, except at full-glass or two-light glass doors requiring narrow stile device. Mounting screws shall be concealed to deter tampering. All ferrous parts shall be zinc coated to prevent rusting.
3. Single point, one quarter turn hex dogging shall be standard on panic listed devices. Optional key cylinder dogging shall be available, and furnished if so indicated in the hardware sets, on panic listed devices. Devices with hex key dogging shall be easily field converted to cylinder dogging.
4. All devices shall be listed by Underwriters Laboratories for safety as panic hardware. Fire rated devices shall be UL listed for A label and lesser class doors, 4' x 8' single and 8 x 8' pair. The model number shall be located on the end cap; devices having the model number located other than on the end cap shall not be acceptable.
5. All exit devices shall have a unitized installation feature and may be cut in the field to size. Devices shall be closed on all sides with no pinch points. The push pad shall be designed to prevent pinching of the fingers when depressed.
6. Exit Device trim to be through bolted. Lever trim to be heavy duty forged escutcheon with free-wheeling levers.
7. All exit devices shall conform to Federal Specification FF-H-1820, and be certified as meeting ANSI A156.3, Grade 1 requirements.

2.6 CYLINDERS

1. Manufacturers:
 1. Scheduled Manufacturer: Schlage
 2. Acceptable Manufacturers: None
2. Requirements:

1. Provide FSIC permanent cylinders/cores key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Replaceable Construction Cores.
 1. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.
 2. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.7 KEYING

1. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
2. Provide cylinders/cores keyed into Owner's existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
3. Requirements:
 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 1. Schlage Everest FSIV cores in S145 keyway, master keyed as directed by the Owner.
 2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. 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).
4. Identification:
 1. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include 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 shall 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.
5. Quantity: Furnish in the following quantities.
 1. Change (Day) Keys: 3 per cylinder/core.
 2. Master Keys: 6.
 3. Control keys: 3.

2.8 KEY CONTROL SYSTEM

1. Manufacturers:
 1. Scheduled Manufacturer: Telkee
 2. Acceptable Manufacturers: HPC, Lund
2. Requirements:
 1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 1. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 2. Provide hinged-panel type cabinet for wall mounting.

2.9 DOOR CLOSERS

1. Manufacturers and Products:
 1. Scheduled Manufacturer and Product: LCN 4110(T) series.
 2. Acceptable Manufacturers: Falcon.
2. Requirements:
 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
 2. Provide door closers with fully hydraulic, full rack and pinion action cast iron cylinder.
 3. Closer Body: 1-1/4 inch (32 mm) diameter, with 5/8 inch (16 mm) diameter 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. Cylinder body to have "FAST" power adjust speed dial to visually indicate spring power.

6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: not permitted.
8. 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.

2.10 ELECTRO-MECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN Senior Swing.
2. Acceptable Manufacturers and Products: Besam Swingmaster MP, Horton 4000LE series.

B. Requirements:

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA A156.19.
 - a. Opening: Powered by DC motor working through reduction gears.
 - b. Closing: Spring force.
 - c. Manual, hydraulic, or chain drive closers: Not permitted.
 - d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
 - e. Cover: Aluminum.
2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, or adapters for arms as required to suit details.
4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
5. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to "KEYING" article, herein.
6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.11 DOOR TRIM

1. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Trimco

2. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.12 PROTECTION PLATES

1. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Trimco

2. Requirements:

1. Provide kick plates, mop plates, and armor plates 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 of plates:
 1. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 2. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 3. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.13 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

1. Manufacturers:
 1. Scheduled Manufacturers: Glynn-Johnson
2. Requirements:
 1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
 2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
 3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
 4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.14 DOOR STOPS AND HOLDERS

1. Manufacturers:
 1. Scheduled Manufacturer: Ives
 2. Acceptable Manufacturers: Burns, Trimco
2. Provide door stops at each door leaf:
 1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
 2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
 3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.15 ACCESS CONTROL READER

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Scheduled Manufacturer and Product: Schlage MT11/ MT15.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements: Read Only Multi-Technology Contactless reader

1. Provide access control card readers manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications are not acceptable
2. Provide multi-technology contactless readers which can read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. Provide multi-technology contactless reader optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards by providing:
 - a. Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
 - b. A migration platform to upgrade from the most popular 125 kHz proximity technologies to MIFARE or MIFARE DESFire EV1 by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.
 - c. Guaranteed compatibility to read all standard data formats ensuring card-to-reader interoperability in multi-location installations and multi-card/reader populations.
 - d. Secure access control data exchange between the smart card and the reader utilizing diversified keys and mutual authentication sequences.
 - e. Universal compatibility with most access control systems.
 - f. Ease of installation through industry standard wiring methods.
 - g. Compatibility with legacy 125 KHz proximity access control formats (all standard formats up to 37 bits, including HID Corporate 1000 formats).
 - h. Optimal read range and read speed for increased access control throughput.
 - i. Global availability.
 - j. Product construction suitable for both indoor and outdoor applications.
 - k. Customizable behavior for indicator lights and beeper.
3. Provide multi-technology contactless readers complying with the following 13.56MHz-related standards to ensure product compatibility and predictability of performance:
 - a. ISO 14443
4. Provide multi-technology contactless readers configurable to read 13.56 MHz data simultaneously from the following cards (multiple credential support based on reader configuration):

- a. Secure support - Mifare DESFire EV1with PACSA, Mifare Classic, FIPS 201 PIV Credential.
 - b. UID/CSN Support – DESFire Classic V0.06, HID iClass, ISOX (my-d).
 - c. Proximity – Schlage Proximity, XID Proximity, HID Prox, AWID, GE/CASI, Lenel Prox, Inside Pictotag, TI Tagit, ST Micro.
5. Provide multi-technology contactless readers configurable to read data from any compatible 125 kHz technology simultaneously with 13.56 MHz data. Compatible 125 kHz technologies include:
 - a. XCEEDID/Schlage/HID Prox (format in the card – formats up to 37-bits supported).
 - b. AWID PROX (SAME AS LENEL PROX - format in the card – formats up to 42-bits).
 - c. GE PROX - two possible format options.
6. Provide multi-technology contactless readers with the ability to read card access data stored in the secure access control sector/application area of the ISO 14443 XceedID MIFARE or MIFARE DESFire EV1 card.
7. Provide multi-technology contactless readers configurable to provide multiple hierarchical degrees of key compatibility for accessing the smart card access control data. Provide compatibility for the following key structure options:
 - a. Compatibility with the default manufacture’s key structure to ensure convenient off the shelf compatibility with manufacture’s cards and readers.
 - b. Compatibility with custom keys managed by manufacturer which provide a site-specific, unique, protected key structure.
 - c. Compatibility with high security customer managed custom keys.
8. Provide multi-technology contactless readers configurable to provide compatibility with all standard Prox formats up to 37 bits (including Corporate 1000®).
9. Provide multi-technology contactless readers which allow the reader firmware to be upgraded in the field without the need to remove the reader from the wall through the use of factory-provided device.
10. Provide multi-technology contactless readers suitable for global deployment by meeting worldwide radio and safety regulatory compliance including:
 - a. FCC Certification (US)
 - b. CE (EU)
 - c. C-tick (Australia, New Zealand)
 - d. R&TTE Directive (15EU)
 - e. UL294 (US)
 - f. ULC-S319

- g. IC (Canada)
 - h. FIPS201 / PIV I
 - i. IP65
11. Provide multi-technology contactless readers fully compliant with Restriction of Hazardous Substances directive (RoHS) restricting the use of specific hazardous materials found in electrical and electronic products.
 12. Provide multi-technology contactless readers with universal compatibility with most access control systems by outputting card data in compliance with the SIA AC-01 Wiegand standard.
 13. Provide multi-technology contactless readers with tamper resistant screws.
 14. Provide multi-technology contactless readers with the ability to transmit an alarm signal via and integrated optical tamper switch if an attempt is made to remove the reader from the wall. Provide tamper switch programmable to provide a selectable action to provide a selectable action compatible with various tamper communication schemes provided by access control panel manufacturers. The selectable action must include one of the following:
 - a. The reader open collector line changes from a high state (5V) to a low state (Ground).
 - b. If utilizing OSDP, provide protocol reader reporting a tamper condition via RS485.
 15. Provide multi-technology contactless readers with the ability to mount to standard electrical boxes using universal international mounting holes.
 16. Provide multi-technology contactless readers with a full potted assembly.
 17. Provide multi-technology contactless readers with a quick connect wire harness.
 18. Provide multi-technology contactless readers with customizable reader behavior options either from the factory, or defined in the field using pre-configured command cards. Reader behavior programming options must include:
 - a. LED & Audio configurations.
 - b. Ability to disable reading of specific card technologies or frequencies.
 - c. ISO 14443/15693 CSN output configuration.
 - d. Wiegand output spacing and timing.
 19. Provide multi-technology contactless readers with the following programmable audio/visual indication:
 - a. Provide an audio beeper tone sequence to signify: access granted, access denied, power up, and diagnostics.
 - b. Provide a light bar with clear visual status (red/green/amber).

20. Provide multi-technology contactless readers designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Provide contactless smart cards with the following power requirements:
 - a. Operating voltage: 5 – 16 VDC, reverse voltage protected. Linear power supply recommended.
 - b. Current requirements: 125 mA DC, 140 mA PEAK @ 12 VDC
21. Provide multi-technology contactless readers meeting the following physical specifications:
 - a. Dimensions: 5.91" x 1.72" x 0.84" (15 cm x 4.4 cm x 2.1cm)
 - b. Weight: 9.6 oz. (272.15 g)
 - c. Material: UL94 Polycarbonate
 - d. Plastics: Consist of three-piece design with mounting plate, potted case and aesthetic cover.
 - e. Color: Black, Gray, Brown or Cream as approved by the project architect.
22. Provide multi-technology contactless readers meeting the following environmental specifications:
 - a. Operating temperature: -31 to 151 degrees F (-35 to 67 degrees C)
 - b. Operating humidity: 5% to 95% relative humidity non-condensing
 - c. Weatherized design suitable to withstand harsh environments
 - 1) Certified rating of IP65
23. Multi-technology contactless reader cabling requirements:
 - a. Cable distance: (Wiegand): 500 feet (150m)
 - b. Cable type: 5-conductor #22 AWG
 - c. Standard reader termination: 18" (0.5m) wire harness

2.16 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

1. Manufacturers:
 1. Scheduled Manufacturer: Zero International
 2. Acceptable Manufacturers: National Guard, Reese
2. Requirements:
 1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
 2. Size of thresholds:

1. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
2. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
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.

2.17 SILENCERS

1. Manufacturers:
 1. Scheduled Manufacturer: Ives
 2. Acceptable Manufacturers: Burns, Trimco
2. 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.

2.18 FINISHES

1. Finish: BHMA 626/652 (US26D); except:
 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 2. Continuous Hinges: BHMA 630 (US32D)
 3. Continuous Hinges: BHMA 628 (US28)
 4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
 5. Protection Plates: BHMA 630 (US32D)
 6. Overhead Stops and Holders: BHMA 630 (US32D)
 7. Door Closers: Powder Coat to Match
 8. Wall Stops: BHMA 630 (US32D)
 9. Latch Protectors: BHMA 630 (US32D)
 10. Weatherstripping: Clear Anodized Aluminum
 11. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

1. 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.
2. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
3. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

1. Where on-site modification of doors and frames is required:
 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 2. Field modify and prepare existing door and frame for new hardware being installed.
 3. When modifications are exposed to view, use concealed fasteners, when possible.
 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 1. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 2. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 3. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

1. Mounting Heights: 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. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
2. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
3. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

4. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
5. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
6. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
7. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
8. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
9. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 1. Replace construction cores with permanent cores as indicated in keying section.
10. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
11. Wiring: Coordinate with Division 26, ELECTRICAL 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. Testing and labeling wires with Architect's opening number.
12. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
13. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
14. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
15. 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.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
16. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
17. 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.
18. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
19. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
20. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

1. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

1. 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. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

1. Clean adjacent surfaces soiled by door hardware installation.
2. Clean operating items as necessary to restore proper function and finish.
3. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

1. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

1. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
2. Hardware Sets:

Manufacturers

H	Hager
I	Ives
L	LCN
S	Schlage
SCE	Schlage Electronics
V	Von Duprin

Hardware Schedules

Hardware Set HW-100					
S	2	Each	Cylinders – Rim or Mortise as Needed	20-001 or 20-022	626
Balance of hardware by aluminum door supplier.					

Hardware Set HW-200					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Passage	L9010 SL1	626
L	1	Each	Closer	4110T	689
L	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Both levers always free for entry or egress.					

Hardware Set HW-201					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Passage	L9010 SL1	626
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Both levers always free for entry or egress.					

Hardware Set HW-300					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Privacy	L9044 SL1	626
L	1	Each	Closer	4110T	689
L	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Coin turn outside; thumbturn inside; latchbolt only. Latchbolt retracted by lever from either side. Outside lever is made inoperative by rotating outside coin turn or inside thumbturn. Rotating outside coin turn unlocks outside lever. Rotating inside thumbturn unlocks outside lever; turning inside lever retracts latchbolt and unlocks outside lever; closing door also unlocks preventing lock-out. Inside lever always free for immediate egress					

Hardware Set HW-301					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Privacy	L9044 SL1	626
L	1	Each	Closer	4010T	689
L	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Coin turn outside; thumbturn inside; latchbolt only. Latchbolt retracted by lever from either side. Outside lever is made inoperative by rotating outside coin turn or inside thumbturn. Rotating outside coin turn unlocks outside lever. Rotating inside thumbturn unlocks outside lever; turning inside lever retracts latchbolt and unlocks outside lever; closing door also unlocks preventing lock-out. Inside lever always free for immediate egress					

Hardware Set HW-400					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Corridor	L9456P SL1 XL13-439	626
L	1	Each	Closer	4010T	689
L	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Key cylinder outside; thumbturn inside; deadbolt and latchbolt. Latchbolt retracted by lever from either side. Outside lever is made inoperative when deadbolt is thrown by key outside or by inside thumbturn. Key outside retracts deadbolt and unlocks outside lever; XL13-439 option allows key to retract deadbolt overriding thumbturn if being held in locked position. Rotating inside lever retracts both deadbolt and latchbolt and unlocks outside lever. Inside lever always free for immediate egress.					

Hardware Set HW-401					
I	3	Each	Hinges	5BB1 4.5 x 4.5	652
S	1	Each	Lock – Corridor	L9456P 06A	626
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Key cylinder outside; thumbturn inside; deadbolt and latchbolt. Latchbolt retracted by lever from either side. Outside lever is made inoperative when deadbolt is thrown by key outside or by inside thumbturn. Key outside retracts deadbolt and unlocks outside lever; XL13-439 option allows key to retract deadbolt overriding thumbturn if being held in locked position. Rotating inside lever retracts both deadbolt and latchbolt and unlocks outside lever. Inside lever always free for immediate egress.					

Hardware Set HW-402					
I	4	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Corridor	L9456P SL1 XL13-439	626
L	1	Each	Closer	4110T	689
L	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Key cylinder outside; thumbturn inside; deadbolt and latchbolt. Latchbolt retracted by lever from either side. Outside lever is made inoperative when deadbolt is thrown by key outside or by inside thumbturn. Key outside retracts deadbolt and unlocks outside lever; XL13-439 option allows key to retract deadbolt overriding thumbturn if being held in locked position. Rotating inside lever retracts both deadbolt and latchbolt and unlocks outside lever. Inside lever always free for immediate egress.					

Hardware Set HW-500					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Classroom	L9070P SL1	626
L	1	Each	Closer	4110T	689
L	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Key cylinder outside with lever; latchbolt and deadlocking auxiliary latch. Latchbolt retracted by lever from either side. Outside lever is made inoperative by key outside. Key outside unlocks outside lever and retracts latchbolt. Inside lever always free for immediate egress					

Hardware Set HW-600					
I	4	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Storeroom	L9080P SL1	626
I	1	Each	Dutch Door Bolt	054	626
I	2	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Exterior lever always locked requiring use of a key for entry. Interior lever always free for immediate egress.					

Hardware Set HW-601					
H	3	Each	Hinges NRP	5BB1 4.5 x 4.5 NRP	652
S	1	Each	Lock – Storeroom	L9080P 06A	626
L	1	Each	Closer	4110T BUMP TBSRT	689
I	1	Each	Floor Stop	FS18S	Black
I	1	Each	Kick Plate	8400 10" x 34" B-CS	630
Z	1	Each	Threshold	655A x 36"	A
Z	1	Each	Weather Strip	238AA 36" x 84"/2	AA
Z	1	Each	Sweep	39A x 36"	A
Z	1	Each	Drip Cap	142AA x 40"	AA
Exterior handle always locked requiring use of a key for entry. Interior lever always free for immediate egress.					

Hardware Set HW-602					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Storeroom	L9080P SL1	626
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Exterior lever always locked requiring use of a key for entry. Interior lever always free for immediate egress.					

Hardware Set HW-603					
I	4	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Storeroom	L9080P SL1	626
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
Exterior lever always locked requiring use of a key for entry. Interior lever always free for immediate egress.					

Hardware Set HW-604					
H	4	Each	Hinges NRP	5BB1 4.5 x 4.5 NRP	652
S	1	Each	Lock – Storeroom	L9080P 06A	626
L	1	Each	Closer	4110T BUMP TBSRT	689
I	1	Each	Floor Stop	FS18S	Black
I	1	Each	Kick Plate	8400 10" x 34" B-CS	630
Z	1	Each	Threshold	655A x 36"	A
Z	1	Each	Weather Strip	238AA 36" x 84"/2	AA
Z	1	Each	Sweep	39A x 36"	A
Z	1	Each	Drip Cap	142AA x 40"	AA
Exterior handle always locked requiring use of a key for entry. Interior lever always free for immediate egress.					

Hardware Set HW-700					
H	3	Each	Hinges NRP	5BB1 4.5 x 4.5 NRP	652
V	1	Each	Panic	99L-06	626
S	1	Each	Cylinder – Rim	20-022	626
L	1	Each	Closer	4110T BUMP TBSRT	689
I	1	Each	Floor Stop	FS18S	Black
I	1	Each	Kick Plate	8400 10" x 34" B-CS	630
Z	1	Each	Threshold	655A x 36"	A
Z	1	Each	Weather Strip	238AA 36" x 84"/2	AA
Z	1	Each	Sweep	39A x 36"	A
Z	1	Each	Drip Cap	142AA x 40"	AA
Exterior handle can be installed to have a storeroom, classroom, or passage functionality. Push bar on interior always allows free egress.					

Hardware Set AC-600					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
S	1	Each	Lock – Passage	L9010 SL1	626
SCE	1	Each	Magnetic Lock	M490	
L	1	Each	Closer	4110T	689
I	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
V	1	Each	Power Supply	PS902-FA	
Card reader by others.					
Magnetic lock to hold door secure from either side. Card reader on either side of the door releases the magnetic lock allowing the lever to be turned and the door to be opened. Magnetic lock to be tied into fire alarm system and to release upon activation of fire alarm. Confirm functionality with local AHJ.					

Hardware Set AC-601					
I	3	Each	Hinges	5BB1 4.5 x 4.5 HT	652
V	1	Each	Electric Strike	6211 FSE	630
S	1	Each	Lock – Storeroom	L9080P SL1	626
L	1	Each	Closer	4110T	689
I	1	Each	Kick Plate	8400 10" x 34" B-CS	630
I	1	Each	Wall Stop	WS406/407CCV	630
H	3	Each	Silencers	307D	Gray
V	1	Each	Power Supply	PS902	
Card reader by others.					
Exterior lever always locked requiring use of a key for entry. Interior lever always free for immediate egress. Upon activation of access control system, electric strike releases and allows the door to be pulled open.					

Hardware Set AC-602					
H	4	Each	Hinges NRP	5BB1HW 5 x 4.5 NRP	652
S	1	Each	Lock – Passage	L9010 SL1	626
SCE	1	Each	Magnetic Lock	M490	
L	1	Each	Closer	4110T BUMP TBSRT	689
I	1	Each	Floor Stop	FS18S	Black
I	1	Each	Kick Plate	8400 10" x 34" B-CS	630
Z	1	Each	Threshold	655A x 36"	A
Z	1	Each	Weather Strip	238AA 36" x 96"/2	AA
Z	1	Each	Sweep	39A x 36"	A
Z	1	Each	Drip Cap	142AA x 40"	AA
V	1	Each	Power Supply	PS902-FA	
Balance of access control components by others.					
Magnetic lock to hold door secure from either side. Card reader on either side of the door releases the magnetic lock allowing the lever to be turned and the door to be opened. Magnetic lock to be tied into fire alarm system and to release upon activation of fire alarm. Confirm functionality with local AHJ.					
In case of power failure or fire alarm, access to the building will be freely granted from this opening.					

ARVAC, Inc Medical Detox and Campus Improvements
Russellville, Arkansas
Bidding & Permitting

Level 5 Architecture
23-20A
April 07, 2025

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulating and single pane glass units.
- B. Monolithic glass.
- C. Glazing compounds.

1.2 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- K. GANA (GM) - GANA Glazing Manual; 2022.
- L. GANA (SM) - GANA Sealant Manual; 2008.
- M. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
- O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples 12 by 12 inch (300 by 300 mm) in size, showing coloration and design of each type of glass specified.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.
- B. Provide each type of glass, primary sealant, and gasket from a single manufacturer with not less than five years documented experience in the production of required materials.
- C. Basis of Design: Specifications for certain glass products are based on specific glass types by the specified basis of design manufacturer. Glass types manufactured by other acceptable manufacturers are permitted, subject to compliance with all performance requirements; and provided that deviations in performance and coloration are minor, and do not detract substantially from the indicated design intent.
 - 1. Comply with requirements specified in Section 01 40 00 and Section 01 60 00.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions for shipping, handling, storing, and protection of glass and glazing materials. Exercise exceptional care to prevent edge damage to glass, and damage to coatings.
- B. Where insulating glass units will be exposed to substantial altitude changes during shipping, comply with manufacturer's recommendations for venting and sealing.

1.6 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.
- C. Install sealants only when ambient temperature conditions can be maintained at or above 40 degrees F (4.44 degrees C) during installation and 48 hours immediately following installation.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with applicable codes.
 - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 4. Design glazing units to reliably perform and remain reliably engaged on all edges under all service and thermal stresses, including those associated with partial shading.
 - 5. Limit center of glass deflection to the lesser of 3/4 inch or L/100 (where L is short side dimension of glass unit), or flexure limit of glass, whichever is less, with full recovery of glazing materials.
 - 6. Assure and confirm compatibility of all materials in contact with each other.
 - 7. Glass thicknesses listed are minimum.
- B. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7.8 computer program.
 - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7.8 computer program.
 - 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.2 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 - 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 - 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 - 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 - 5. Impact Resistant Safety Glass: Complies with ANSI Z97.1 - Class B, or 16 CFR 1201 - Category I criteria.
 - 6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.3 INSULATING GLASS UNIT APPLICATIONS

- A. Acceptable Insulating Glass Unit Manufacturers:
 - 1. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. General - Combined Requirements: If a particular glass unit is indicated to comply with more than one type of requirement, such as color, safety characteristics, or other requirements, comply with all specified requirements for each type as scheduled on Drawings.
- C. Insulating Glass Units: Types as indicated on Drawings.
 - 1. Basis of Design: As specified in this Section below.
 - 2. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 3. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 - 4. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
 - a. Spacer Width: As required for specified insulating glass units.
 - b. Spacer Height: Manufacturer's standard.
 - c. Acceptable Products:
 - 1) Quanex IG Systems, Inc.; Super Spacer TriSeal: www.quanex.com.
 - 2) Technoform Glass Insulation; TGI-Spacer: www.glassinsulation.us.
 - 3) Viracon, Inc.; VTS Thermal Spacer: www.viracon.com/#sle.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
 - 5. Spacer Color: Black.
 - 6. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone sealant as secondary seal applied around perimeter.
 - b. Color: Black.
 - 7. Purge interpane space with dry air, hermetically sealed.
 - 8. Breather Tubes: Provide tubes from air space for insulating glass units without inert type gas that have a change of altitude greater than 2500 feet (762 m) between point of fabrication and point of installation to permit pressure equalization of air space.
 - a. Breather Tubes: Seal breather tubes upon installation in accordance with insulating glass fabricator's requirements.
- D. Insulating Glass Units: Vision glass, double glazed.
 - 1. Basis of Design: As specified in this Section below.
 - 2. Space between lites filled with air.
 - 3. Outboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum. Provide fully tempered units where required by code.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 - 4. Warm-edge spacer.
 - 5. Inboard Lite: Heat-strengthened float glass (fully tempered where required by code), 1/4 inch (6.4 mm) thick, minimum. Provide fully tempered units where required by code.
 - a. Tint: Clear.
 - 6. Total Thickness: 1 inch (25.4 mm).
 - 7. Visible Light Transmittance (VLT): Refer to Drawings.
 - 8. Solar Heat Gain Coefficient (SHGC): Refer to Drawings, nominal.
 - 9. Glazing Method: Dry glazing method, gasket glazing.
- E. Insulating Glass Units: Spandrel glazing.
 - 1. Applications: Exterior spandrel glazing unless otherwise indicated.
 - 2. Outboard Lite: Heat-strengthened float glass (fully tempered where required by code), 1/4 inch (6.4 mm) thick, minimum.

- a. Tint: Clear.
 - b. Coating: Same as on vision units, on #2 surface.
 - 3. Inboard Lite: Heat-strengthened float glass (full tempered where required by code), 1/4 inch (6.4 mm) thick.
 - a. Tint: Clear.
 - b. Opacifier: Ceramic frit, on #3 surface.
 - c. Opacifier Color: Selected by Architect from manufacturer's full line.
 - F. Insulating Glass Units: Safety glazing.
 - 1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Locations required by applicable federal, state, and local codes and regulations.
 - d. Where recommended by manufacturer due to wind loading.
 - e. Other locations specified or indicated on Drawings.
 - 2. Glass Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.
- 2.4 BASIS OF DESIGN - INSULATING GLASS UNITS
- A. Insulating Glass Units: Vision glazing, with Low-E coating.
 - 1. Applications: Exterior insulating glass glazing unless otherwise indicated.
 - 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
- 2.5 MONOLITHIC GLAZING UNITS
- A. General - Combined Requirements: If a particular glass unit is indicated to comply with more than one type of requirement, such as color, safety characteristics, or other requirements, comply with all specified requirements for each type as scheduled on Drawings.
 - B. Monolithic Interior Vision Glazing:
 - 1. Applications: Interior glazing unless otherwise indicated.
 - 2. Glass Type: Annealed float glass.
 - 3. Tint: Clear.
 - 4. Thickness: Refer to Drawings.
 - C. Monolithic Safety Glazing: Non-fire-rated.
 - 1. Applications:
 - a. Glazed lites in doors, except fire doors.
 - b. Shower and bathtub enclosures and doors.
 - c. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - d. Locations required by applicable federal, state, and local codes and regulations.
 - e. Other locations specified or indicated on the Drawings.
 - 2. Glass Type: Fully tempered safety glass as specified.
 - 3. Tint: Clear.
 - 4. Thickness: Refer to Drawings.
- 2.6 GLAZING COMPOUNDS
- A. General Requirements:
 - 1. Provide black exposed glazing accessory materials, unless specifically indicated otherwise.
 - 2. Provide materials of hardness as recommended by manufacturer for required application and condition of installation in each case. Provide only compounds which are known to be fully compatible with surfaces contacted, including glass products, seals, and glazing channel surfaces.
 - B. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

- C. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; black color.

2.7 ACCESSORIES

- A. Setting Blocks: Silicone or EPDM, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Silicone or EPDM, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 - 1. Width: As required for application.
 - 2. Thickness: As required for application.
 - 3. Spacer Rod Diameter: As required for application.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
 - 1. Size gaskets as required by manufacturer of glazing channel frame to provide proper pressure and bite on glazing units.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.
- D. Sealed Insulating Glass Units: Seal breather tubes immediately prior to glass unit installation with bead of silicone sealant according to sealed insulating glass unit manufacturers requirements; do not crimp, bend, or otherwise damage breather tubes.

3.3 INSTALLATION - GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners; do not block weep paths.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Place setting blocks at 1/4 points and install glazing pane or unit; do not block weep paths.
- C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch (610 mm) intervals, 1/4 inch (6.4 mm) below sight line.
- D. Fill gaps between glazing and stops with butyl type sealant to depth of bite on glazing, but not more than 3/8 inch (9 mm) below sight line to ensure full contact with glazing and continue the air and vapor seal.
- E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.6 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length and set against permanent stops, 3/16 inch (5 mm) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- D. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners; do not block weep paths.
- E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
- F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch (6.4 mm) below sight lines.
 - 1. Place glazing tape on glazing pane of unit with tape flush with sight line.
- G. Fill gap between glazing and stop with butyl type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch (9 mm) below sight line.
- H. Apply cap bead of butyl type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.7 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.8 PROTECTION

- A. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
 - 1. Acoustical assemblies.
 - 2. Shaftwall assemblies.
 - 3. Fire-rated assemblies.
- B. Metal stud wall framing.
- C. Suspended metal ceiling framing.
- D. Acoustic insulation.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.
- G. Textured finish system.

1.2 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- H. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2020).
- I. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- J. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- M. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- N. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
- O. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- P. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- Q. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- S. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
- T. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

- V. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- W. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- X. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- Y. GA-238 - Guidelines for Prevention of Mold Growth on Gypsum Board; 2019.
- Z. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.
- AA. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- BB. UL (FRD) - Fire Resistance Directory; Current Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with mechanical and electrical work. Do not attach or support metal framing to ducts, pipes, conduit, or similar items.
 - 2. Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
- C. Steel Framing Industry Association (SFIA) Certification:
 - 1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.
- D. Manufacturer's installation instructions for each product proposed for use.
- E. Control joint layout for walls and ceilings, complying with ASTM C840.
- F. Product Certificates:
 - 1. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the joint firestopping products for installation with or near its piping system.
 - 2. Certifying the joint firestopping products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.

1.5 QUALITY ASSURANCE

- A. SFIA Code Compliance Certification Program: www.CFSteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.
- B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Stud Framing: Products that do not comply with ASTM C645 or ASTM C754 are not permitted.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store and protect products in accordance with referenced standards. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
- C. Stack gypsum panels flat to prevent sagging.
- D. Handle gypsum boards to prevent damage to ends, edges, and surfaces.
- E. Do not bend or damage metal corner beads and trim.
- F. Do not exceed design loads for the floor joists. Stack perpendicular to floor joists.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures at not less than 40 degrees F for non-adhesive attachment of gypsum board, and not less than 50 degrees F for adhesive attachment.
- B. Maintain ambient temperatures at not less than 50 degrees F for a period 48 hours before gypsum board finishing, during installation, and after installation of board materials.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216 as applicable.
- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 56-58 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. ICC (IBC) Item Numbers: Comply with applicable requirements of ICC (IBC) for the particular assembly.
 - 2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
 - 3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
 - 4. Where any specified rated assembly requires the use of proprietary gypsum board system products, installation methods or procedures, comply with specified rated assembly requirements including requirements associated with assembly options which may be selected by Contractor.
 - 5. Design Loads: As indicated on Drawings for designated assemblies.
 - a. Framing System Components - General: Maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).

2.2 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
- B. Acceptable Manufacturers:
 - 1. ClarkDietrich: www.clarkdietrich.com.
 - 2. Marino: www.marinoware.com.
 - 3. R-stud, LLC: www.rstud.com.
 - 4. SCAFCO Corporation: www.scafco.com.
 - 5. Steel Construction Systems: www.steelconstruction.com.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Metal Framing - General: Provide framing materials complying with specified standards and tested assemblies; galvanized sheet steel, 25 gage unless specified, noted, scheduled, or detailed otherwise.
- D. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.

- E. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
 - 1. Acceptable Manufacturers:
 - a. Same manufacturer as other framing materials.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.

2.3 CEILING SUSPENSION SYSTEM COMPONENTS

- A. Gypsum Board Interior Ceiling Suspension System:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for conditions and spacing required.
 - 2. Ceiling Hanger Wire: ASTM A641/A641M, Class 1 coating; soft temper, pre-stretched, yield stress load at least three times design load, but not less than 12 gage.
 - 3. Ceiling Hanger Angles: Not less than 7/8 x 7/8 inch x 16 gage galvanized steel formed angles; ASTM A653/A653M, G90 coating, with minimum 5/16 diameter bolted connections.
 - 4. Ceiling Hanger Anchors: Size for three times imposed loads, as determined by ASTM E488/E488M; corrosive resistant materials with loops or holes for attachment of hanger wires.
- B. Direct Hung Grid Suspension System for Interior Ceilings: ASTM C635/C635M; direct-hung system composed of main runners and cross-furring runners that interlock; size hanger wires for three times imposed loads, as determined by ASTM E488/E488M; corrosive resistant materials.
 - 1. Acceptable Products:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems: www.armstrongceilings.com.
 - b. Rockfon North America; Chicago Metallic Drywall Grid: www.rockfon.com.
 - c. USG Corporation; Drywall Suspension System: www.usg.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.4 BOARD MATERIALS

- A. Acceptable Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company: www.americangypsum.com.
 - 2. CertainTeed Corporation: www.certainteed.com.
 - 3. Georgia-Pacific Gypsum, LLC: www.gp.com/gypsum.
 - 4. Gold Bond Building Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com.
 - 5. PABCO Gypsum: www.pabco gypsum.com.
 - 6. USG Corporation: www.usg.com.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Applications: Use for vertical surfaces, unless otherwise indicated.
 - 2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X or C board, UL or WH listed.
 - 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm) and 1/2 inch (12 mm) in locations indicated.
 - b. Ceilings: As required for fire-resistance rated assembly indicated on Drawings.
 - 4. Acceptable Paper-Faced Products: Use type required by indicated tested assembly; if no tested assembly is indicated, provide the following:
 - a. CertainTeed Corporation; Gypsum Board: www.certainteed.com.
 - b. Georgia-Pacific Gypsum, LLC; ToughRock Brand Gypsum Wallboard: www.gpgypsum.com.
 - c. National Gypsum Company; Gold Bond Brand Gypsum Board: www.goldbondbuilding.com.
 - d. USG Corporation; Sheetrock Brand Gypsum Panels: www.usg.com.
- C. Backing Board For Wet Areas:
 - 1. Glass-Mat-Faced Backing Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.

- a. Standard Type Thickness: 5/8 inch (16 mm) and 1/2 inch (12 mm) in locations indicated.
- b. Fire Resistant Type Thickness: Type X core, 5/8 inch (16 mm).
- c. Edges: Tapered.
- d. Acceptable Products:
 - 1) CertainTeed Corporation; 5/8" GlasRoc Tile Backer Type X: www.certainteed.com/#sle.
 - 2) National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.
 - 3) USG Corporation; Durock Brand Glass-Mat Tile Backerboard 5/8 in. (15.9 mm): www.usg.com/#sle.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Applications: Ceilings, unless otherwise indicated.
 2. Thickness: As required for fire-resistance-rated assembly indicated on Drawings.
 3. Basis of Design: USG Corporation; Sheetrock Brand Panels: www.usg.com.
 4. Acceptable Products:
 - a. Basis of Design: USG Corporation; Sheetrock Brand Panels: www.usg.com.
 - b. CertainTeed Corporation; Interior Ceiling Drywall: www.certainteed.com/#sle.
 - c. CertainTeed Corporation; 1/2" Easi-Lite: www.certainteed.com/#sle.
 - d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond High Strength LITE Gypsum Board: www.goldbondbuilding.com/#sle.
- E. Exterior Soffit and Ceiling Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut, with additives to enhance sag resistance of core and water repellent paper on front and back faces and long edges.
 1. Applications: Ceilings and soffits in protected exterior areas, and breezeway walls where not subject to water exposure, unless otherwise indicated.
 2. Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
 3. Types: Type C, or as otherwise indicated on the Drawings.
 4. Width: 4 feet.
 5. Length: 8 feet through 12 feet
 6. Edges: Tapered.
 7. Acceptable Products:
 - a. American Gypsum Company; Exterior Soffit Gypsum Wallboard Type X: www.americangypsum.com/#sle.
 - b. CertainTeed Corporation; 5/8" Soffitboard Type C: www.certainteed.com/#sle.
 - c. CertainTeed Corporation; 5/8" Soffitboard Type X: www.certainteed.com/#sle.
 - d. Georgia-Pacific Gypsum; ToughRock Fireguard C Soffit Board: www.gpgypsum.com/#sle.
- F. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (600 mm) wide, beveled long edges, ends square cut.
 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 2. Acceptable Glass Mat Faced Products:
 - a. American Gypsum Company; M-Glass Shaft Liner: www.americangypsum.com/#sle.
 - b. CertainTeed Corporation; GlasRoc Shaftliner Type X: www.certainteed.com/#sle.
 - c. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant): www.gpgypsum.com/#sle.
 - d. National Gypsum Company; Gold Bond eXP Shaftliner: www.goldbondbuilding.com/#sle.
 - e. USG Corporation; Sheetrock Brand Glass-Mat Liner Panels Mold Tough 1 in. (25.4 mm): www.usg.com/#sle.

2.5 ACOUSTICAL ACCESSORIES

- A. Resilient Furring Channels: ASTM C645 galvanized steel sheet, 25 gage thickness; 1/2 inch (12 mm) depth, for attachment to substrate through one leg only.

1. Acceptable Manufacturers:
 - a. ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
 - b. CEMCO; California Expanded Metal Company; RC1-XD: www.cemcosteel.com.
 - c. Phillips Manufacturing Co.; RC-1 Tru-25 Resilient Sound Channel: www.phillipsmfg.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - B. Acoustic Insulation: ASTM C612; semi-rigid mineral fiber, unfaced; flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Thickness: Full thickness of indicated wall framing, and 3-1/2 inches thick to comply with specified floor/ceiling assembly rating requirements.
 2. Density: Minimum 0.5 pounds per cubic foot where used in rated floor/ceiling assembly and specified wall assemblies.
 - C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 1. Comply with volatile organic compound (VOC) content and emissions restrictions specified in Section 01 61 16 - VOC Content and Emissions Restrictions.
 2. Acceptable Products:
 - a. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
 - b. Liquid Nails, a brand of PPG Architectural Coatings: www.liquidnails.com/#sle.
 - c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.
- 2.6 INSTALLATION AND FINISHING ACCESSORIES
- A. Special Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - B. Beads, Joint Accessories, and Other Trim ASTM C1047 galvanized steel or rolled zinc
 1. Types: As detailed or required for finished appearance.
 2. Corner Beads: Low profile, for 90 degree outside corners, with perforated legs.
 3. Control Joints: One-piece, v-grooved control joint with integral perforated flanges; removable tape to protect v-groove during finishing.
 - a. Applications: Locations specifically noted on Drawings; also located at internal corners, wall locations at re-entrant soffit corners, and ceiling locations at re-entrant soffit corners whether or not specifically noted on Drawings.
 - C. Joint Materials: ASTM C475/C475M, and as recommended by gypsum board manufacturer for project conditions.
 1. Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 2. Joint Compound: Drying type, vinyl-based, ready-mixed.
 3. Joint Compound for Wet and Exterior Locations: Chemical quick-setting type for first 2 coats, and vinyl type top coat specially formulated for finishing topping.
 - a. Exposed Soffit Board Locations: Chemically hardening setting-type joint compound for prefilling joints as recommended by soffit board manufacturer to minimize joint imperfections.
 - D. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
 - E. Textured Finish Materials: Latex-based compound; plain.
 1. Acceptable Products:
 - a. CertainTeed Corporation; Extreme Texture Coat/Acrylic Texture with M2Tech: www.certainteed.com/#sle.
 - b. Sherwin-Williams; Tuff Surface Premium Texture Finish: www.sherwin-williams.com/#sle.
 - F. Screws for Fastening of Gypsum Panel Products to Wood Members: ASTM C1002; self-tapping screws, corrosion-resistant.
 - G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness: ASTM C1002; self-piercing tapping screws, corrosion-resistant; cadmium-plated for exterior locations.

- H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant, black phosphate coated.
- I. Nails for Attachment to Wood Members: ASTM C514.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this Section before commencing work of this Section.

3.2 INSTALLATION - GENERAL

- A. Prevention of Mold Growth on Gypsum Board: GA-238.
 - 1. Keep gypsum board dry throughout application.
 - 2. Do not use gypsum board that has visible mold growth.
 - 3. Gypsum Board on Walls: Install leaving a minimum 1/4" (6 mm) gap between gypsum board and finished floor.
 - 4. Do not apply gypsum board over other building materials where conditions exist favorable to mold growth.

3.3 SHAFT WALL INSTALLATION

- A. Shaft Wall Stud Framing: Install in accordance with GA-600 requirements and manufacturer's installation instructions.
 - 1. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Coreboard: Cut panels to accurate dimensions and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
 - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.4 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits:
 - 1. Space ceiling suspension components at spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 2. Direct Hung Ceiling Suspension System Installation:
 - a. 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.
 - 1) Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - b. 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.
 - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - c. 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.
 - d. Do not connect or suspend steel framing from ducts, pipes, or conduit.
 - e. Attach perimeter wall track or angle where support system meets vertical surfaces.
 - f. Mechanically join support members to each other and cut to fit into wall track.
 - g. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
- C. Stud Framing: Space studs as permitted by standard or as specified below.

1. Length of power actuated fasteners for stud wall tracks at post-tensioned concrete slabs is limited to 3/4 inch embedment, unless otherwise specified on structural Drawings; no exceptions.
 2. Space studs 16 inches on center, except as otherwise indicated or required by specified tested assemblies, and secure to floor and ceiling runners with screws.
 3. Provide supplemental framing matching primary wall framing to support cut edges of gypsum boards not supported by primary vertical wall framing members.
 4. Extend partition framing to structure in all locations, unless otherwise indicated on Drawings.
 5. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 6. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
 7. Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support free from axial loading. Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from plane of faces of adjacent framing.
- D. Framing Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
1. Access Doors: Coordinate placement of openings for access doors and hatches with Architect before framing opening. Avoid placing openings at highly visible locations on wall and ceilings. Refer to Section 08 31 00.
 2. Where walls terminate at ceiling plane, extend vertical door jamb studs through suspended ceiling and attach to underside of structure above.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
1. Orientation: Horizontal.
 2. Spacing: As indicated.
- F. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.
- G. Blocking: Install wood blocking for support of the following items:
1. Framed openings.
 2. Wall-mounted cabinets.
 3. Plumbing fixtures.
 4. Toilet partitions.
 5. Toilet accessories.
 6. Wall-mounted door hardware including, but not limited to, door stops.
 7. Handrails and guardrails.

3.5 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustical Furring: Install resilient channels to framing at maximum 24 inches (600 mm) on center. Locate gypsum board joints only over resilient channel members.
1. Install with open leg facing up.
 2. Do not screw through gypsum board and resilient channel to wall stud; use screws that are only long enough to engage gypsum board and resilient channel.
- B. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
- D. STC-rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant.
1. Install acoustical sealant at both faces of partitions at perimeters and through penetrations.
 2. Place continuous bead at perimeter of each layer of gypsum board.
 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

4. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.6 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated Applications: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
 1. Gypsum Wallboard Panels to Resilient Channels: Install in accordance with fire-resistance-rated assembly indicated at spacing(s) indicated. Install so that gypsum wallboard attachment screws do not make contact with framing members or other components within wall or ceiling cavity, with the exception of inadvertent contact with non-rigid type wall or ceiling cavity insulation.
- D. Exterior Ceiling and Soffit Board Applications: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.
 1. Seal joints, cut edges, and holes with water-resistant sealant.

3.7 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces, in accordance with ASTM C840 awings, and as follows:
 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
 2. At exterior soffits, not more than 30 feet (10 meters) apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations shown on the Drawings. Provide vent area specified.

3.8 JOINT TREATMENT

- A. Glass-Mat-Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with ready-mixed, vinyl-based joint compound and finish with ready-mixed, vinyl-based joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated or specified.
 2. Level 4: Walls and ceilings to receive flat or eggshell paint finish without textured wall finish, unless otherwise indicated or specified.
 3. Level 3: Walls and ceilings to receive textured wall finish, unless otherwise indicated or specified.
 4. Level 2: In utility areas, behind cabinetry.
 5. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
 2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
- E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.9 TEXTURE FINISH

- A. Prime gypsum board surfaces prior to applying texture.
- B. Walls and Ceilings: Apply finish texture coating by means spraying apparatus in accordance with manufacturer's instructions, . Apply over clean surfaces after completion of taping and finishing work.

1. Walls: Spatter knock-down texture unless noted otherwise on Drawings.
2. Ceilings: Spatter knock-down texture unless noted otherwise on Drawings.

3.10 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.11 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Stone thresholds.
- D. Ceramic trim.
- E. Non-ceramic trim.

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.
- C. ASTM C241/C241M - Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic; 2009.
- D. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- E. ASTM C503/C503M - Standard Specification for Marble Dimension Stone; 2023.
- F. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.
- G. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this Section; require attendance by all affected installers.
 - 1. Convene under general provisions of Section 01 70 00.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than one box of each type.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of ANSI A108/A118/A136, TCNA (HB), and TCNA (HB-GP) on-site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this Section, with minimum five years of documented experience.
- C. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.7 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting and grout materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: All products by the same manufacturer.
 - 1. American Olean Corporation: www.americanolean.com/#sle.
 - 2. Dal-Tile Corporation: www.daltile.com/#sle.
 - 3. Summitville Tiles, Inc.: www.summitville.com.
 - 4. Tile manufacturers as listed in ID Finish Schedule/Legend.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
 - a. Acceptability of substituted items may be determined solely on the basis of design, appearance, or finish.

2.2 TILING MATERIALS - GENERAL

- A. Refer to ID Finish Schedule/Legend. Should anything in this section be at variance with the ID documents, the ID documents shall govern.

2.3 TILING MATERIALS

- A. Glazed Wall Tile: ANSI A137.1, standard grade.
 - 1. Moisture Absorption: 3.0 to 7.0 percent percent as tested in accordance with ASTM C373.
 - 2. Size: Refer to ID Finish Schedule/Legend.
 - 3. Edges: Cushioned.
 - 4. Surface Finish: Refer to ID Finish Schedule//Legend.
 - 5. Color(s): Refer to ID Finish Schedule/Legend.
- B. Porcelain Wall Tile: ANSI A137.1, standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size and Shape: Refer to ID Finish Schedule/Legend.
 - 3. Edges: Cushioned.
 - 4. Face: Plain.
 - 5. Colors and Surface Finish: Refer to ID Finish Schedule/Legend.
- C. Porcelain Floor Tile: ANSI A137.1, standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size and Shape: Refer to ID Finish Schedule/Legend.
 - 3. Thickness: 3/8 inch (9.5 mm).
 - 4. Edges: Cushioned.
 - 5. Colors and Surface Finish: Refer to ID Finish Schedule/Legend.
 - 6. Slip Resistance: Meet requirements of applicable codes.

2.4 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 - 1. Applications:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base.
 - 2. Acceptable Manufacturer: Same as for corresponding tile.
- B. Metal Trim: Satin natural anodized extruded aluminum (unless otherwise indicated in ID Finish Schedule), style, configuration, and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall and floor tile.

- b. Inside and outside wall corners.
 - c. Transition between floor finishes of different heights.
 - d. Thresholds at door openings.
 - e. Floor to wall joints, where specified floor and wall tile do not have manufactured coved units.
 - f. Borders and other trim as indicated on Drawings.
- C. Thresholds (common areas only where indicated): 2 inches (51 mm) wide by one piece full width of wall or frame opening; beveled edge on one long edge with radiused corners on top side; without holes, cracks, or open seams.
- 1. Thickness: 1/2 inch (12.7 mm).
 - 2. Material: Marble.
 - 3. Color: White or gray.
 - 4. Applications:
 - a. At doorways where tile terminates.

2.5 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Acceptable Manufacturers:
- 1. ARDEX Engineered Cements: www.ardexamericas.com.
 - 2. Bostik Inc.: www.bostik-us.com.
 - 3. Custom Building Products: www.custombuildingproducts.com.
 - 4. LATICRETE International, Inc.: www.laticrete.com.
 - 5. Mapei; mapei.com
- C. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
- 1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.
 - a. Acceptable Products:
 - 1) Custom Building Products; MegaLite: www.custombuildingproducts.com/#sle.
 - 2) LATICRETE International, Inc; 254 Platinum: www.laticrete.com/#sle.
 - 3) Mapei Corporation; Ultraflex: www.mapei.com.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
- D. Organic Adhesive: ANSI A136.1, thinset mastic type.
- 1. Applications: Where indicated or specified.
 - 2. Use Type I in areas subject to prolonged moisture exposure.
 - 3. Acceptable Products:
 - a. Custom Building Products; ReliaBond Ceramic Tile Adhesive - Type 1: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc.; LATICRETE 15 Premium Mastic: www.laticrete.com.
 - c. Mapei Corporation; Type 1 - Ultramastic ECO: www.mapei.com.

2.6 GROUTS

- A. Acceptable Manufacturers:
- 1. Custom Building Products: www.custombuildingproducts.com.
 - 2. Custom Building Products: www.custombuildingproducts.com.
 - 3. LATICRETE International, Inc.: www.laticrete.com.
 - 4. Mapei Corporation: www.mapei.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Standard Grout: ANSI A118.6 standard cement grout.
- 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
 - 3. Color(s): As selected by Architect or ID from manufacturer's full line.
 - 4. Acceptable Products:
 - a. Custom Building Products; Polyblend Sanded Grout/Sanded Grout: www.custombuildingproducts.com.

- b. LATICRETE International, Inc.; LATICRETE 1500 Sanded Grout/1600 Unsanded Grout:
www.laticrete.com.
- c. Mapei Corporation; Keracolor S/U: www.mapei.com
- d. Substitutions: See Section 01 60 00 - Product Requirements.

2.7 ACCESSORY MATERIALS

- A. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Mortar Bonded Sheet Type:
 - a. Material: Chlorinated polyethylene sheet membrane with polyester fabric laminated to both sides, 40 mils (1 mm), thick, minimum.
 - b. Acceptable Products:
 - 1) Noble Company; NobleSeal TS: www.noblecompany.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.
- F. Verify water-resistant, fiberglass faced gypsum board has been installed where tile is to be installed in showers and tubs.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Broom clean surfaces and damp clean.
- C. Repair substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Blending: For tile exhibiting color or pattern variations within the ranges of accepted submittals, verify that tile has been blended in the packages so that tile units taken from one package show same range in colors or patterns as those taken from other packages. If not blended in the packages, blend tile in the field before installation.
- C. Install crack isolation membrane to comply with ANSI A118.10 and membrane manufacturer's written instructions for width of one full tile over joint or crack plus one full tile width on each side of center tile, minimum width of 3 tiles.
- D. Movement Joints: Comply with TCNA (HB) Method EJ171F requirements for locations, spacing, and installation of applicable movement joints, whether or not specifically indicated or detailed on Drawings, and as follows:
 - 1. Spacing - Interior: Maximum 24 feet on center in each direction; reduce spacing to maximum 10 feet on center in areas exposed to direct sunlight or moisture.

2. Joint Width: Match adjacent grouted joint widths, unless TCNA EJ171 requires a specific joint width based on joint location or joint service conditions.
 3. Apply sealant joint to junction of tile and dissimilar materials and junction of dissimilar planes, including but not limited to floor to wall joints, corners, and metal trim and non-ceramic accessory items.
 4. Keep movement joints free of setting adhesive and grout.
 5. Form internal angles and corners square, not grouted, with sealant joint.
 6. Form external angles and corners square, not grouted, with sealant joint.
 7. Apply specified sealant to joints.
 - E. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
 - F. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
 - G. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
 - H. Install non-ceramic trim in accordance with manufacturer's instructions.
 - I. Install thresholds where indicated.
 - J. Sound tile after setting. Remove and replace hollow sounding units.
 - K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
 - L. Grout tile joints, except where movement joints are indicated or specified.
 - M. Seal joints between tile work and other work with sealant specified in Section 07 92 00.
- 3.4 INSTALLATION - WATERPROOFING SYSTEM
- A. Install complete system in accordance with specified manufacturer's requirements to maintain specified warranty.
- 3.5 INSTALLATION - FLOORS - THIN-SET METHODS
- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, latex-Portland cement bond coat, unless otherwise indicated.
 1. Grout Type: Standard grout, unless otherwise indicated.
 2. Use crack isolation membrane under all tile meeting or exceeding definition of large format tile units in nominal face dimension, and also where specified.
 3. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
 4. Where gypsum underlayment substrate is indicated, install in accordance with TCNA (HB), Method F180, without underlayment.
 - B. Over wood substrates, install in accordance with TCNA (HB) Method F142, with standard grout.
 1. Grout Type: Standard grout.
- 3.6 INSTALLATION - SHOWER AND BATHTUB WALLS
- A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
 1. Grout Type: Standard grout with grout sealer.
 2. Maximum Slope to Drains: Comply with ADA Standards; 2.0 percent, unless otherwise restricted by referenced standard.
 - B. At shower walls install in accordance with TCNA (HB) Method B412 over shower enclosure system specified in this Section.
 1. Grout Type: Standard grout with grout sealer.
 - C. At bathtub walls install in accordance with TCNA (HB) Method B412, over cementitious backer units with waterproofing membrane.
 1. Grout Type: Standard grout with grout sealer.
 - D. Grout: Standard grout.
 - E. Seal joints between tile work and other work, and joints within shower and bathtub enclosures, with sealant specified in Section 07 92 00.

3.7 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
 - 1. Grout Type: Standard grout.

3.8 TOLERANCES

- A. Comply with applicable requirements of ANSI A108.2, unless otherwise specified in this Section.
- B. Flatness - Finished Tiling Surfaces:
 - 1. Ceramic Tile: 1/4 inch in 10 feet.
 - 2. Pressed Tile and Porcelain Tile: 1/4 inch in 10 feet.
 - 3. Stone Tile: 1/8 inch in 10 feet.
- C. Lippage - Adjacent Tile Units:
 - 1. Wall Tile Installations - Severe Lighting: 1/32 inch; joint width 1/16 inch to less than 1/4 inch; all tile sizes.
 - 2. Glazed Tile and Mosaic Tile: 1/32 inch; joint width 1/16 inch to 1/8 inch; 1 x 1 inch to 6 x 6 inch tile size.
 - 3. Stone Tile: 1/16 inch; joint width 1/4 inch or greater; 6 x 6 inch to 8 x 8 inch tile size.
 - 4. Pressed Floor Tile and Porcelain Tile: 1/32 inch; joint width 1/16 inch to less than 1/4 inch; all tile sizes.
 - 5. Pressed Floor Tile and Porcelain Tile: 1/16 inch; joint width greater than 1/4 inch; all tile sizes.

3.9 CLEANING

- A. Clean tile and grout surfaces as soon as possible.
- B. Clean grout smear and haze from tile in accordance with tile and grout manufacturer's written instructions.
- C. Leave finished installation clean and free of cracked, chipped, broken, un-bonded, or otherwise defective tile work.

3.10 PROTECTION

- A. Do not permit traffic over finished floor surface for minimum 4 days after installation or longer if in accordance with manufacturer's written instructions.
- B. Protect installed tile work with kraft paper or other heavy covering during the construction period, in order to prevent staining, damage or wear.

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
 - 1. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Submit two full size samples illustrating material and finish of acoustical units.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Two, unopened cartons of the acoustical units; one, unopened box of clips; and some grid members..

1.5 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

1.6 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 20 to 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer - Acoustic Panels:
 - 1. USG Corporation: www.usg.com/ceilings/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Other Acceptable Manufacturers - Acoustic Panels:
 - 1. Armstrong World Industries, Inc.: www.armstrongceilings.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Acceptable Manufacturers - Suspension Systems:

1. Same as for acoustical units.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- 2.2 ACOUSTICAL CEILINGS
- A. Refer to ID Finish Schedule/Legend. Should anything in this section be at variance with the ID documents, the ID documents shall govern.
 - B. Acoustical Units - General: ASTM E1264, Class A.
- 2.3 CEILING PANEL MATERIALS
- A. Acoustical Panels: Painted mineral fiber, with the following characteristics:
 1. Classification: ASTM E1264 Type III.
 - a. Form: 2, water felted.
 - b. Pattern: "B" - perforated, randomly spaced large holes.
 2. Size: 24 by 24 inches (610 by 610 mm), unless otherwise indicated on Drawings.
 3. Color: White.
 4. Suspension System: Exposed grid.
 5. Basis of Design Product: Refer to ID Finish Schedule/Legend.
 - a. Substitutions: See Section 01 60 00 - Product Requirements.
- 2.4 SUSPENSION SYSTEMS
- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 1. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
 2. Finish: Manufacturer's standard, unless otherwise specified for grid type and location.
 - B. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 2. Profile: Tee; 15/16 inch (24 mm) face width or as otherwise indicated in the ID Finish Legend/Schedule.
 3. Finish: Baked enamel.
 4. Color: White.
- 2.5 ACCESSORIES
- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
 - B. Hanger Wire: Minimum 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
 - C. Hold-Down Clips: Manufacturer's standard clips to suit application.
 - D. Perimeter Trim Profiles: Same material and finish as grid.
 1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
 - E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

- 3.1 EXAMINATION
- A. Verify existing conditions before starting work.
 - B. Verify that layout of hangers will not interfere with other work.
- 3.2 PREPARATION
- A. Install after major above-ceiling work is complete.
- 3.3 INSTALLATION - SUSPENSION SYSTEM
- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
 - B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
 - C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges; finish cut edges to match factory finished edges if cut edge is exposed to view.
 - 3. Double cut and field paint exposed reveal edges to match factory finished edges.
- F. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- G. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.

3.5 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 65 00 - RESILIENT FLOORING AND BASE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient wall base.
- C. Flooring system accessories.

1.2 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.
- B. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- D. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2023.
- E. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2021a.
- F. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
- G. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
- H. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- I. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- J. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Materials: Provide 2 percent of installed resilient product of each type and color specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store materials in manufacturer's original unopened containers, with brand names and production lot numbers clearly marked.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a minimum temperature of 65 degrees F (18 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C) and not exceeding 85 degrees F, unless otherwise restricted by flooring manufacturer. Maintain temperature and relative humidity at the same levels during installation, and after installation.
 - 1. Protect roll materials from damage by storing on end.

PART 2 PRODUCTS

2.1 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
 - 1. Minimum Requirements: Comply with ASTM F1066, Class 1.
 - 2. Size: Refer to ID Finish Schedule/Legend.
 - 3. Thickness: 0.125 inch (3.2 mm), unless otherwise indicated.

4. Acceptable Product: Refer to ID Finish Schedule/Legend.
- B. Vinyl Plank Flooring: Solid vinyl with color and pattern throughout thickness.
 1. Minimum Requirements: Comply with ASTM F1700, Type B Embossed, Class corresponding to type specified.
 2. Size: Manufacturer's standard.
 3. Total Thickness: 0.080 inch (2 mm).
 4. Acceptable Product: Refer to ID Finish Schedule/Legend.
- C. Rubber Tile: Homogeneous, color and pattern throughout thickness.
 1. Acceptable Manufacturers:
 - a. Action Floor Systems, LLC: www.actionfloors.com.
 - b. Amarco Products: www.amarco.com.
 - c. American Floor Products Company, Inc.: www.americanfloorproducts.com.
 - d. Ecore International: www.ecoreintl.com.
 - e. Horner Flooring Company, Inc.: www.hornerflooring.com.
 - f. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - g. Mondo America Inc.: www.mondocontractflooring.com.
 - h. Musson Rubber Company: www.mussonrubber.com.
 - i. Pawling Corp.; www.pawling.com.
 2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
 3. Size: 24 by 24 inch (610 by 610 mm) nominal, unless otherwise indicated.
 4. Total Thickness: 0.4 inch (10 mm), unless otherwise indicated.
 5. Color and Pattern: Refer to ID Schedule/Legend.

2.2 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset Style B, Cove.
 1. Acceptable Manufacturers:
 - a. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - b. Mannington Commercial: www.manningtoncommercial.com#sle.
 - c. Roppe Corporation: www.roppe.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Height: Refer to ID Finish Schedule/Legend.
 3. Thickness: 0.125 inch (3.2 mm) thick or as otherwise indicated in ID Finish Schedule/Legend.
 4. Finish: Satin.
 5. Length: Roll.
 6. Color: Refer to ID Finish Schedule/Legend.
 7. Accessories: Premolded external corners and end stops.

2.3 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer for specified flooring products and indicated substrate conditions.
- C. Moldings, Transition and Edge Strips: Resilient rubber, unless otherwise indicated.
- D. Filler for Coved Base: Plastic type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Moisture Vapor Emission: ASTM F1869.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
 - D. Verify that required floor-mounted utilities are in correct location.
- 3.2 PREPARATION
- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
 - B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
 - C. Prohibit traffic until filler is fully cured.
 - D. Clean substrate.
- 3.3 INSTALLATION - GENERAL
- A. Starting installation constitutes acceptance of subfloor conditions.
 - B. Install in accordance with manufacturer's written instructions.
 - C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
 - D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
 - F. Install without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections
- 3.4 INSTALLATION - TILE AND PLANK FLOORING
- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
 - B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- 3.5 INSTALLATION - RESILIENT BASE
- A. Fit joints tightly and make vertical. Install in longest lengths possible; maintain minimum dimension of 18 inches (45 mm) between joints.
 - B. Miter internal corners. At external corners, use premolded units.
 1. At exposed ends, use premolded units.
 - C. Install base on solid backing. Bond tightly to wall and floor surfaces.
 - D. Scribe and fit to door frames and other interruptions.
- 3.6 CLEANING
- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
 - B. Clean in accordance with manufacturer's written instructions.
- 3.7 PROTECTION
- A. Prohibit traffic on resilient flooring for 48 hours after installation.
 - B. Remove damaged tiles and replace with new, undamaged tiles all at no cost to the Owner.
 - C. Protect installed products until completion of project.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.2 REFERENCE STANDARDS

- A. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver carpeting materials in original mill protective wrapping, with mill register numbers and tags attached.
- B. Store inside, in well ventilated area, protected from weather, moisture, and soiling.

1.6 FIELD CONDITIONS

- A. Stage materials in area of installation for minimum period of 24 hours prior to installation.
- B. Maintain minimum 70 degrees F (21 degrees C) ambient temperature 24 hours prior to, during and 24 hours after installation.
- C. Ventilate installation area during installation and for 72 hours after installation.
- D. Do not commence with carpet installation until painting and finishing work is complete and ceilings and overhead work has been tested, approved, and completed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Manufacturers and products specified in ID Finish Schedule/Legend.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
 - a. Acceptability of substituted items may be determined solely on the basis of design, appearance or finish.

2.2 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Non-Metallic Edge Strips: Extruded or molded heavy duty vinyl or rubber type; 1-1/2 inch wide, with minimum 2 inch wide anchorage flange; colors selected by Architect from manufacturer's standards.
- C. Resilient Wall Base: Specified in Section 09 65 00.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.
- E. Miscellaneous Materials: Provide other items recommended by carpet manufacturer and installer for the indicated conditions of carpet use, and as required for complete installation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 09 05 61.
 - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in indicated pattern, with pile direction alternating to next unit, set parallel to building lines unless otherwise indicated on Drawings.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Resilient Strips: Attach to substrate using adhesive.

3.4 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 81 16 - ACOUSTICAL BLANKET INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Concealed building insulation for acoustical purposes.

1.2 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- F. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E84.
 - 2. Fire-Resistance Ratings: ASTM E119.
 - 3. Combustion Characteristics: ASTM E136 .

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. 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. Glass-Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville Corporation.
 - c. Owens Corning.
 - 2. Slag-Wool-/Rock-Wool-Fiber Insulation:
 - a. Fibrex Insulations Inc.
 - b. Owens Corning.
 - c. Thermafiber.

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Unfaced Mineral-Fiber Blanket Insulation (in walls): ASTM C665 , Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- C. Unfaced, Flexible Glass-Fiber Blanket Insulation (above ceilings): ASTM C612 , Type IA; ASTM C553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:
 1. Nominal density of 1.0 lb/cu. ft., thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F.
 2. Nominal density of not less than 1.5 lb/cu. ft. nor more than 1.7 lb/cu. ft., thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.
 3. Combustion Characteristics: Passes ASTM E136 .

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
 1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

3.5 PROTECTION

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

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of exterior painting and coating systems.
- C. Field application of interior painting and coating systems.
- D. Scope:
 - 1. Finish exterior and interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - a. Exterior:
 - 1) Metal, Miscellaneous: Iron, structural iron and steel, ferrous metal (including shelf angles).
 - 2) Wood: Boards and panels.
 - 3) Drywall: Gypsum board and exterior drywall.
 - b. Interior:
 - 1) Metal: Aluminum and galvanized.
 - 2) Metal: Miscellaneous iron iron and steel, structural iron, and ferrous metal.
 - 3) Exposed surfaces of steel lintels and ledge angles.
 - 4) Elevator pit ladders.
 - 5) Wood: Doors and trim.
 - 6) Unfinished surfaces inside cabinets.
 - 7) Both sides and all edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 8) Back-prime wood trim, cut edges, and concealed surfaces specified to be finished prior to installation.
 - 9) Gypsum Board: Walls, ceilings, and similar applications.
 - 10) Prime surfaces to receive wall coverings and all surfaces to be painted.
 - 11) Mechanical and Electrical:
 - (a) In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - (b) In finished areas, paint shop-primed items.
 - (c) On the roof and outdoors, paint all equipment that is exposed to weather or to view, including that which is factory-finished. Do not paint HVAC units or transformers.
- 2. Do not paint or finish the following:
 - a. Items fully factory-finished, unless specifically otherwise indicated. Products having factory-applied primers are not considered factory finished.
 - b. Items indicated to receive other finishes.
 - c. Items indicated to remain unfinished.
 - d. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - e. Stainless steel, anodized aluminum, bronze, terne, and lead items.
 - f. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
- B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Product characteristics.
 - 2. Surface preparation instructions and recommendations.
 - 3. Primer requirements and finish specification.
 - 4. Storage and handling requirements and recommendations.
 - 5. Application methods.
 - 6. Clean-up information.
 - 7. VOC content.
 - C. Samples: Submit two paper chip samples in size illustrating range of colors and textures available for each surface finishing product scheduled.
 - D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
 - E. Maintenance Materials: Minimum one, unopened gallon of each enamel and latex paint color. Store where directed by Owner.
- 1.4 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
 - B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
 - B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
 - C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.
- 1.6 FIELD CONDITIONS
- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
 - B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
 - C. Do not apply exterior coatings in windy and dusty conditions
 - D. Do not apply exterior coatings in direct sunlight or on surfaces which will soon be warmed by the sun.
 - E. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
 - F. Ventilate affected areas during paint application.
 - G. Exhaust solvent vapors outdoors, away from air intakes and people.
 - H. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
 - I. Provide minimum lighting level of 80 ft candles measured mid-height at substrate surface during application of materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- B. Other Acceptable Manufacturers - Paints:
 - 1. Benjamin Moore & Co.: www.benjaminmoore.com.
 - 2. Frazee Paint, a Sherwin-Williams Company: www.frazee.com.
 - 3. PPG Paints: www.ppgpaints.com/#sle.
 - 4. Valspar Corporation: www.valsparpaint.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

- C. Acceptable Manufacturers - Primer Sealers: Same manufacturer as top coats; no exceptions.

2.2 PAINTINGS AND COATINGS

- A. General:
1. Provide factory-mixed coatings unless otherwise indicated.
 2. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
 4. Furnish each paint material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site, or other method acceptable to authorities having jurisdiction.
- D. Flammability: Comply with applicable code for surface burning characteristics.
- E. Colors: Refer to ID Finish Schedule/Legend.
1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
 2. Obtain clarification of intended color at locations where color is not indicated on schedule or drawings.
- F. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.3 PAINT SYSTEMS - EXTERIOR

- A. Metal: Iron, steel, ferrous metal:
1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
(a) 5 to 10 mils wet, 1.8 to 3.6 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.
(a) 2. to 4 mils dry per coat.
- B. Galvanized Metal:
1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
(a) 5 to 10 mils wet, 1.8 to 3.6 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.
(a) 2.5 to 4 mils dry per coat.
- C. Wood: Boards.
1. Latex Systems:

- a. Satin Finish:
 - 1) 1st Coat: Sherwin-Williams Latex Wood Primer, B42W8041: www.sherwin-williams.com/#sle.
 - (a) 4 mils wet, 1.4 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams A-100 Exterior Latex Satin, A82 Series: www.sherwin-williams.com/#sle.
 - (a) 4 mils wet, 1.5 mils dry per coat.
 - D. Cement Board:
 - 1. Satin Finish:
 - a. 1st Coat: Sherwin-Williams Loxon Concrete & Masonry Primer, LX02 Series: www.sherwin-williams.com/#sle.
 - 1) 2.1 mils wet, 0.6 mils dry.
 - b. 2nd and 3rd Coat: Sherwin-Williams A-100 Exterior Latex Satin, A82 Series: www.sherwin-williams.com/#sle.
 - 1) 4 mils wet, 1.5 mils dry per coat.
 - E. Drywall: Gypsum board and exterior drywall.
 - 1. Latex Systems:
 - a. Satin Finish:
 - 1) 1st Coat: Sherwin-Williams Latex Wood Primer, B42W8041: www.sherwin-williams.com/#sle.
 - (a) 4 mils wet, 1.4 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams A-100 Exterior Latex Satin, A82 Series: www.sherwin-williams.com/#sle.
 - (a) 4 mils wet, 1.5 mils dry per coat.
- 2.4 PAINT SYSTEMS - INTERIOR
- A. Metal: Aluminum and galvanized.
 - 1. Latex Systems:
 - a. Eg-Shel/Satin Finish High Performance:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
 - (a) 5 mils wet, 2 mils dry per coat.
 - 2) 2nd and 3rd Coats: Sherwin-Williams Pro Industrial Acrylic Eg-Shel, B66-660 Series: www.sherwin-williams.com/#sle.
 - (a) 2 to 4 mils dry per coat.
 - B. Metal: Ferrous Metal: Hollow metal doors, frames, access doors/frames, handrails, and miscellaneous items exposed to view and not otherwise scheduled
 - 1. Latex Systems:
 - a. Eg-Shel/Satin Finish High Performance:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
 - (a) 7 mils wet, 2.5 mils dry per coat.
 - 2) 2nd and 3rd Coats: Sherwin-Williams Pro Industrial Acrylic Gloss, B66-600 Series: www.sherwin-williams.com/#sle.
 - (a) 2.5 to 4 mils dry per coat.
 - C. Wood: Walls, ceilings, doors, and trim.
 - 1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Easy Sand Oil-Based Primer, B49W8040: www.sherwin-williams.com/#sle.
 - (a) 5 mils wet, 2.2 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProClassic Waterborne Acrylic Semi-Gloss, B31 Series: www.sherwin-williams.com/#sle.

- (a) 4 mils wet, 1.3 mils dry per coat.
- D. Gypsum Board: Walls, ceilings, gypsum board, and similar items.
 - 1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 400 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 400 Zero VOC Latex Semi-Gloss, B31-2600 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - b. Eg-Shel Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 400 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 400 Zero VOC Eg-Shel, B20-2600 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.7 mils dry per coat.
 - c. Low Sheen Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 400 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 400 Zero VOC Latex Low Gloss Eg-Shel, B41-1950 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.6 mils dry per coat.
 - d. Flat Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 400 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 400 Zero VOC Latex Flat, B30-2600 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.6 mils dry per coat.

2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide commercial quality primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. If substrate preparation is the responsibility of another installer, notify General Contractor of unsatisfactory preparation before proceeding.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

- A. Do not begin application of coatings until substrates have been properly prepared.

- B. Remove or repair existing coatings that exhibit surface defects. Fill nail holes, cracks, chips, spalls, and similar damaged areas to match adjacent undamaged areas.
- C. Clean surfaces thoroughly and correct defects prior to application.
- D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- E. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- F. Seal surfaces that might cause bleed through or staining of topcoat.
- G. Remove mildew from impervious surfaces by scrubbing with solution of water and bleach. Rinse with clean water and allow surface to dry.
- H. Mask permanent labels.
- I. Cement Board: Remove dirt, dust and other foreign matter. Pressure clean, if needed, to remove grease, oil, and loose particles.
- J. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.
- K. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- L. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.
- M. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with clear sealer.
- N. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- O. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- P. Uncorroded Ferrous Metal:
 - 1. Remove grease, mill scale, weld splatter, dirt, and rust.
 - 2. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent.
 - 3. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
 - 4. Shop-Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces.

3.3 APPLICATION

- A. Unless within an attic or concealed space, all gypsum board is to receive at least one coat of primer and one coat of paint.
- B. Paint all galvanized roof penetrations.
- C. Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- F. Apply products in accordance with manufacturer's written instructions.
- G. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.
- H. Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage.
- I. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- K. Sand wood and metal surfaces lightly between coats to achieve required finish.

- L. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- M. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 PRIMING

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to top coat manufacturers.

3.5 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace electrical cover plates, hardware, light fixture trim, escutcheons, finish hardware, fixtures, and fittings removed prior to painting..

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
- C. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with Painting and Decorating Contractors of America Standard PDCA P1.
- D. Protect finished coatings from damage until completion of project.
- E. Touch Up for Previously Coated Surfaces:
 - 1. Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
 - 2. Properly prepare and touch up scratched, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
 - 3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
 - 4. Touch up fasteners, welded surfaces and surrounding, field connections and areas on which shop coat has been abraded or damaged with specified primer before corrosion or other damage occurs from exposure.
- F. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Handicapped parking signs.
- B. Signs required for Building Code compliance and building occupancy.
- C. Permanent building signage and graphics will be provided under separate Owner contract.

1.2 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When unit and room numbers to appear on signs differ from those on Drawings, include the Drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package unit and room signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Best Sign Systems, Inc.: www.bestsigns.com.
 - 2. Inpro: www.inprocorp.com/#sle.
 - 3. Mohawk Sign Systems, Inc.: www.mohawksign.com.
 - 4. Seton Identification Products: www.seton.com/aec.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Unless otherwise specified for an individual product or material, supply all products specified in this Section from the same manufacturer.

2.2 CODE-REQUIRED SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs:
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 - 3. Character Height: 1 inch (25 mm).
 - 4. Sign Height: 3 inches (75 mm), unless otherwise indicated.
 - 5. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Code-Required Door and Room Signs: Provide all signs required by Authority Having Jurisdiction (AHJ) for building occupancy; determine requirements and report to Owner and Architect prior to making specified submittals. Include cost of these signs in Contract Sum.

2.3 SIGN TYPES

- A. Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Square.
 - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: As scheduled.
 - 4. Character Color: Contrasting color.

2.4 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 - 1. Total Thickness: 1/16 inch (1.6 mm).

2.5 HANDICAPPED PARKING SIGNS

- A. Basis of Design: Best Sign Systems, Inc.; Traffic Signs No. SS04 with SS52: www.bestsigns.com.
- B. Screen printed, 18 gage bonderized steel with blue baked enamel finish and white screen printed copy.
- C. Size: 12 inches by 18 inches and 12 inches by 6 inches.
- D. Copy:
 - 1. "Handicapped Parking Only".
 - 2. "Van Accessible".
- E. Post: Galvanized pipe column minimum 9 feet long.

2.6 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights in accordance with ADA Standards and ICC A117.1.
- D. Locate signs where indicated. If no location is indicated, obtain Architect's instructions.
 - 1. Unit and Room Signs: Locate on wall at latch side of door with tactile characters located minimum 48 inches above finished floor and maximum 60 inches (1440 mm) above finished floor, and 3 inches from door frame, unless indicated otherwise.

- E. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 21 23 - CURTAIN TRACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Recessed overhead curtain track and guides.
- B. Cubicle curtains.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Owner-installed curtains.
- B. Section 05 50 00 - Metal Fabrications: Track supports above ceiling.
- C. Section 06 10 00 - Rough Carpentry: Blocking and supports for track.
- D. Section 09 51 00 - Acoustical Ceilings: Ceiling system to support track.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 by 12 inch (300 by 300 mm) sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention .

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cubicle Track and Curtains:
 - 1. A. R. Nelson Co: www.arnelson.com/#sle.
 - 2. Construction Specialties, Inc; Track Systems: www.c-sgroup.com/#sle.
 - 3. Imperial Fastener Co., Inc: www.imperialfastener.com/#sle.
 - 4. Inpro: www.inprocorp.com/#sle.
 - 5. Krieger Textiles; Cubicle Fabrics: www.kriegertextiles.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 TRACKS AND TRACK COMPONENTS

- A. Tracks: Extruded aluminum sections; one piece per track run.
 - 1. Profile: Channel.
 - 2. Mounting: Recessed.
 - 3. Structural Performance: Capable of supporting vertical test load of 50 lbs (23 kg) without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 - 4. Track End Stop: To fit track section.
 - 5. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
 - 6. Suspension Rods: Tubular aluminum sections, sized to support design loads and designed to receive attachment from track and ceiling support.

7. Escutcheons: Where suspension rod meets finished ceiling or structure, provide escutcheons to match rod finish.
 8. Finish on Exposed Surfaces: Clear anodized.
 9. Products:
 - a. American Track Supply; Aluminum Track: www.americantracksupply.com/#sle.
 - B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
 1. Provide __ carriers per foot of track length (__ carriers per meter of track length)
 - C. Wand: Plastic, attached to lead carrier, for pull-to-close action.
 - D. Installation Accessories: Types required for specified mounting method and substrate conditions.
- 2.3 CURTAINS
- A. Cubicle Curtains:
 1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 2. Material: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
 - B. Curtain Fabrication:
 1. Width of curtain to be 10 percent wider than track length.
 2. Length of curtain to end 15 inches (380 mm) above finished floor.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install curtain track to be secure, rigid, and true to ceiling line.
- B. Install curtains on carriers ensuring smooth operation.

END OF SECTION

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Common area toilet accessories.
- B. Residential toilet, shower, and bath accessories.
- C. Under-lavatory pipe supply covers.
- D. Utility room accessories.

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).
- F. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.5 QUALITY ASSURANCE

- A. Provide accessories by the same manufacturer for each type of accessory unit, and for units exposed in the same areas, to ensure matching of finishes.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver accessories to site until rooms in which they are to be installed are ready to receive them.
- B. Deliver materials to site in Manufacturer's original unopened packaging with labels intact.
- C. Pack accessories individually in a manner to protect accessory and its finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Toilet Accessories:
 - 1. American Specialties, Inc.: www.americanspecialties.com.
 - 2. Better Home Products: www.betterhomeproducts.com.
 - 3. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 - 4. Bradley Corporation: www.bradleycorp.com.

5. Pamex Inc.: www.pamexinc.com.
6. Substitutions: Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 1. Grind welded joints smooth.
 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Keys: Provide two keys for each accessory to Owner;; master key all lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Adhesive: Two component epoxy type, waterproof.
- F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FINISHES

- A. Finishes: Refer to ID Finish Schedule/Legend.
- B. Stainless Steel: Satin finish, unless otherwise noted.
- C. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.
- D. Back paint components where contact is made with building finishes to prevent electrolysis.

2.4 COMMON AREA TOILET ACCESSORIES

- A. Basis of Design: Refer to ID Finish Schedule/Legend.
- B. Grab Bars: Stainless steel, smooth surface.
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 - b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Lengths and Configuration: As indicated on drawings.

2.5 SHOWER AND TUB ACCESSORIES

- A. Basis of Design: Refer to ID Finish Schedule/Legend.

2.6 RESIDENTIAL TOILET, SHOWER, AND BATH ACCESSORIES

- A. Basis of Design: Refer to ID Finish Schedule/Legend.

2.7 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
 3. Construction: 1/8 inch (3.2 mm) flexible PVC.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - b. Comply with ASTM C1822, type indicated.
 - c. Comply with ASME A112.18.9.
 - d. Comply with ICC A117.1.
 - e. Microbial and Fungal Resistance: Comply with ASTM G21.
 4. Color: White.
 5. Acceptable Products:
 - a. Plumberex Specialty Products, Inc; Plumberex Handy-Shield Maxx: www.plumberex.com/#sle.
 - b. Plumberex Specialty Products, Inc; Plumberex Trap Gear: www.plumberex.com/#sle.
 - c. Plumberex Specialty Products, Inc; Plumberex Pro-Extreme: www.plumberex.com/#sle.

2.8 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
 - 1. Drying Rod: Stainless steel, 1/4 inch (6 mm) diameter.
 - 2. Hooks: Two, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
 - 3. Mop/Broom Holders: 3 spring-loaded rubber cam holders at shelf front.
 - 4. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on Drawings.
- D. See Section 06 10 00, 061053, and 09 21 16, as applicable, for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.
- D. Use concealed fasteners wherever possible.
- E. Where exposed mounting devices and fasteners are necessary, provide such devices finished to match accessory; use security type fasteners for all exposed accessory mountings.
- F. Unless otherwise indicated, align accessory units with adjacent fixtures and other elements within the same area. Conform to ICC A117.1 for mounting structural strength, positions, and mounting heights.

3.4 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.
- B. Protect adjacent or adjoining finished surfaces and work from damage during installation of work of this Section.
- C. Protect exposed accessory finishes from damage until final acceptance of the Work.

3.5 CLEANING AND ADJUSTMENT

- A. Clean and polish all exposed surfaces after installation, and after removal of labels and protective coatings or coverings.
- B. Test and adjust accessories for proper and smooth operation.
- C. Replace damaged toilet and bath accessories prior to Substantial Completion.

END OF SECTION

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.2 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate cabinet physical dimensions, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.4 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer:
 - 1. Potter-Roemer: www.potterroemer.com.
- B. Other Acceptable Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
 - 2. Kidde, a unit of United Technologies Corp.: www.kidde.com.
 - 3. Larsen's Manufacturing Co.: www.larsensmfg.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 FIRE EXTINGUISHERS

- A. General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Stored Pressure Operated: Deep Drawn.
 - 2. Class: A:B:C type.
 - 3. Sizes: 10 pound (4.54 kg) in common areas and 2.5 pound (1.13 kg) in living units.
 - 4. Finish: Baked polyester powder coat red color.
 - 5. Temperature Range: -65 degrees F (-54 degrees C) to 120 degrees F (49 degrees C).

2.3 CABINETS

- A. Fire Rated Cabinet Construction: One-hour fire rated, unless otherwise required.
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.

2. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where installed.
 - B. Cabinet Configuration: Provide semi-recessed type as available for wall thickness, unless otherwise indicated or specified.
 1. Sized to accommodate scheduled items and accessories.
 2. Projected Trim: Returned to wall surface, with 2-1/2 inch (64 mm) projection maximum, and minimum 1 inch (25 mm) wide face.
 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim.
 - C. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
 - D. Door Glazing: Tempered glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
 - E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
 - F. Fabrication: Weld, fill, and grind components smooth.
 - G. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
 - H. Finish of Cabinet Interior: White colored enamel.
- 2.4 ACCESSORIES
- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.
 - B. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

- 3.1 EXAMINATION
- A. Verify walls and partitions have suitable framing depth and blocking where recessed and semi-recessed cabinets are to be installed
 - B. Verify rough openings for cabinet are correctly sized and located.
 - C. Verify that fire extinguishers are properly charged and tagged. Remove and replace damaged, defective, or undercharged units.
- 3.2 INSTALLATION
- A. Install in accordance with manufacturer's instructions.
 - B. Fire Extinguisher Cabinets: Install cabinets plumb and level in wall openings, maximum 30 inches (762 mm) from finished floor to inside bottom of cabinet, unless otherwise indicated.
 - C. Secure rigidly in place.
 - D. Place extinguishers in cabinets and on wall brackets.
 - E. Clean cabinet before installing fire extinguisher.

END OF SECTION

SECTION 10 71 13.13 - EXTERIOR SHUTTERS

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. PVC composite shutters.
 - B. Shutter hardware.
- 1.2 REFERENCE STANDARDS
 - A. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- 1.3 SUBMITTALS
 - A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
 - B. Product Data: Manufacturer's data sheets on each product to be used.
 - C. Shop Drawings: Show materials, layout, dimensions, profiles, fasteners and anchors, hardware, finishes, and interface with adjacent construction.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver materials to site in manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.
 - B. Store materials in a clean, cool and dry area in accordance with manufacturer's instructions. Do not leave unopened shutters in direct sunlight.
- 1.5 WARRANTY
 - A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
 - B. Provide 10 year manufacturer warranty for shutters.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. PVC Composite Shutters:
 - 1. Timberlane; Endurian: www.timberlane.com.
 - a. Profile: Fixed Louver; WL1.
- 2.2 EXTERIOR SHUTTERS
 - A. Type and Style: As indicated on Drawings.
 - B. Thickness: 1 inch (25 mm), nominal, unless otherwise indicated.
- 2.3 PERFORMANCE REQUIREMENTS
 - A. Shutters to withstand specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M.
 - B. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
- 2.4 MATERIALS
 - A. PVC Composite: Shutters fabricated from individual components of PVC composite and other materials noted below.
 - 1. Color: As selected by Architect from manufacturer's standard line of colors.
- 2.5 HARDWARE AND ACCESSORIES
 - A. Manufacturer's standard clips and nails. Use concealed anchors where possible.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Do not begin installation until substrates have been properly prepared.

- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Commencement of work will imply acceptance of substrate.

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.

3.3 INSTALLATION

- A. Install shutters in accordance with manufacturer's instructions for mounting indicated.
- B. Install level and plumb.

3.4 PROTECTION

- A. Protect installed products from damage by weather and other work until Date of Substantial Completion.
- B. Touch-up and repair damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 10 99 00 - MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Specialty items not covered in other sections.
- 1.2 SUBMITTALS
 - A. General: Submit following items in accordance with Section 013000.
 - B. Product Data: Include all pertinent performance characteristics and criteria.
 - C. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.
 - D. Manufacturer's Instructions: For installation, maintenance, and repair.
- 1.3 DELIVERY, STORAGE AND HANDLING
 - A. Deliver, store, handle, and protect products in accordance with Section 016000.

PART 2 PRODUCTS

- 2.1 PRODUCTS
 - A. Televisions:
 - 1. Acceptable Products:
 - a. Samsung; UN43DU7200FXZA.
 - b. Samsung; UN70DU7200FXZA.
 - B. Television Wall Mounts:
 - 1. Acceptable Products:
 - a. Best Buy Essentials; BE-MLFM.
 - b. Rocketfish; RF-HTMF19.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify that surfaces and conditions are ready to receive work of this Section.
 - B. Notify Architect of any existing conditions which will adversely affect execution.
 - C. Beginning of execution will constitute acceptance of existing conditions.
- 3.2 PREPARATION
 - A. Prepare substrate surfaces as recommended by manufacturer.
- 3.3 INSTALLATION
 - A. Install in accordance with manufacturer's printed instructions and recommendations.
- 3.4 ADJUSTING
 - A. Adjust and fit items to be flush with adjacent construction.
 - B. Fasten or adhere for tight connections and joints.
- 3.5 CLEANING
 - A. Perform final cleaning in accordance with Division 01 Section "Closeout Procedures".
- 3.6 PROTECTION
 - A. Protect finished installation.

END OF SECTION

SECTION 11 73 00 - PATIENT CARE EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Patient-bed locators.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of components. Indicate location and size of each field connection.
 - 3. Include diagrams for service connections and power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches (254 mm) long in size.
- D. Samples for Initial Selection: For each type of exposed finish.
 - 1. Include Samples of accessories involving color and finish selection.
- E. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:
 - 1. Include Samples of accessories to verify color and finish selection.
 - 2. Patient-Bed Locators: Not less than 10 inches (254 mm) square.
- F. Product Schedule: For patient care equipment. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For products to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. 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 installation of the following as shown on Drawings :
 - a. Patient-bed locators.
 - 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design above-ceiling supplementary framing for support and anchorage of patient-lift systems.

2.2 PATIENT-BED LOCATORS

- A. Patient-Bed Locator: Surface-mounted docking station with conduit raceway provisions for eight power-service connections, four on each side, that is UL listed and labeled and complying with NFPA 70, and that ensures proper positioning of patient beds and protects wall surfaces from impact and abrasion damage caused by contact with patient bed.

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. Amico Corporation.
 - b. Hill-Rom.
 - c. Hospital Systems, Inc.
2. Basis-of-Design Manufacturer: Amico Corporation.
3. Enclosure: Manufacturer's standard high-impact plastic.
 - a. Color and Pattern: As selected by Architect from manufacturer's full range.
 - b. Size and Overall Depth: As indicated on Drawings.
4. Power Services:
 - a. Normal power.
 - b. Critical power.
 - c. Low-voltage power and communication.
5. Accessories:
 - a. Direct and indirect lighting fixture.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PATIENT-BED LOCATORS

- A. Install bed locators level and plumb, according to manufacturer's written instructions.
- B. Accurately fit, align, securely fasten, and install bed locators free from distortion or defects.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: For patient-bed service walls, perform periodic installation inspections to ensure that products are installed according to manufacturer's written instructions.
 1. Installation Inspections: Inspect product installations when installation work is 25, 60, and 100 percent complete.
 2. Installation Inspection Reports: Indicate if product installations comply with manufacturer's written instructions and corrective actions required if any.

3.4 ADJUSTING

- A. Adjust products for proper function and operation to comply with manufacturer's written instructions.

3.5 PROTECTION

- A. Protect installed products from damage for the remainder of the construction period.
- B. Repair damaged products according to manufacturer's written instructions. If damaged products cannot be successfully repaired, as determined by Architect, remove and replace damaged products.

END OF SECTION

SECTION 12 24 00 - WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior manual roller shades.

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- C. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with window installation and placement of concealed blocking to support shades.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
- D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- E. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of this type with minimum three years of documented experience with shading systems of similar size and type.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer:
 - 1. Refer to ID Finish Schedule/Legend.
 - 2. As specified in this Section or on Drawings for each shade and fabric type.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Other Acceptable Manufacturers - Interior Manually Operated Roller Shades:
 - 1. BTX, Inc.: www.btxinc.com.
 - 2. Draper, Inc.: www.draperinc.com.
 - 3. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
 - 4. Levolor: www.commercial.levolor.com.
 - 5. Lutron Electronics Co., Inc.: www.lutron.com.
 - 6. Mecho: www.mechoshade.com.
 - 7. TimberBlindMetroShade: www.timberblinds.com/commercial-division.
 - 8. SWFcontract, a division of Springs Window Fashions, LLC: www.swfcontract.com.
 - 9. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 ROLLER SHADES

A. General:

1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
2. Provide shade system that operates smoothly when shades are raised or lowered.
3. Manually Operated Shades: Comply with ADA Standards for operating pull force; maximum 5 lb.

B. Manually Operated Roller Shades:

1. Description: Single roller, manually operated fabric window shades.
 - a. Drop Position: Regular roll.
 - b. Mounting: Wall mounted.
 - c. Fabric: As selected by Architect from manufacturer's full line
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Steel, 1/8 inch (3 mm) thick.
3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - d. Capable of being removed and reinstalled without affecting roller shade limit adjustments.
4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
 - a. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
 - b. Brake must withstand minimum pull force of 50 lb (22.7 kg) in the stopped position.
 - c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 lb (43 kg) minimum breaking strength. Provide upper and lower limit stops.
 - a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
7. Managed Lift: Required lifting force of 3 lb (1.4 kg) to a maximum of 8.5 lb (3.9 kg) for single-band or multi-band shades up to 5 bands and a maximum of 30 lb (13.6 kg) hanging weight.
8. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; fabric wrapped finish to match shade.
 - 1) Configuration: Captured; fascia stops at bracket end.
 - b. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.3 SHADE FABRIC

A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.

1. Acceptable Manufacturers:
 - a. MechoShade Systems LLC: www.mechoshade.com.
 - b. Mermet Corporation: www.mermetusa.com.
 - c. Phifer, Inc.: www.phifer.com.
 - d. Twitchell Technical Products, LLC: www.twitchellcorp.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
2. Material: 100 percent polyester.
3. Performance Requirements:

- a. Flammability: Pass NFPA 701 large and small tests.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
 - 4. Openness Factor: As selected by Interior Designer from manufacturer's full line.
 - 5. Roll Width: 72 inches (1829 mm), maximum.
 - 6. Color: As selected by Interior Designer from manufacturer's full range of colors.
 - 7. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
 - b. Battens: Full width of shade, enclose in welded shade fabric pocket.
- 2.4 ROLLER SHADE FABRICATION
 - A. Field measure finished openings prior to ordering or fabrication.
 - B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
 - 3. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.
 - C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Examine finished openings for deficiencies that may preclude satisfactory installation.
 - B. Start of installation shall be considered acceptance of substrates.
- 3.2 PREPARATION
 - A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
 - B. Coordinate with window installation and placement of concealed blocking to support shades.
- 3.3 INSTALLATION
 - A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
 - B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
 - C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.
- 3.4 CLEANING
 - A. Clean soiled shades and exposed components as recommended by manufacturer.
 - B. Replace shades that cannot be cleaned to "like new" condition.
- 3.5 PROTECTION
 - A. Protect installed products from subsequent construction operations.
 - B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 36 00 - COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Counter tops for architectural cabinet work.
- B. Counter tops for manufactured casework.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- E. NSF 51 - Food Equipment Materials; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizing and configuration of countertops with associated casework and adjacent construction.
 - 2. Coordinate sizing and locations of cutouts for plumbing fixtures with base cabinet configurations for proper alignments as indicated on Drawings.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other Sections.
 - 1. Include countertop seam/joint locations; approval of locations is required prior to fabrication.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 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, with a minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- C. Provide protective coverings and take special precautions at corners.

1.7 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. As specified in this Section for each countertop type and application.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
 - a. Acceptability of substituted items may be determined solely on the basis of design, appearance or finish.

2.2 COUNTERTOPS - GENERAL

- A. Quality Standard:
 - 1. Countertops: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless specified otherwise.

2.3 COUNTERTOP MATERIALS

- A. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, nonporous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - 3. Acceptable Manufacturers:
 - a. Avonite Surfaces: www.avonitesurfaces.com.
 - b. Dupont: www.corian.com.
 - c. Formica Corporation: www.formica.com.
 - d. Wilsonart: www.wilsonart.com.
 - 4. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - 5. NSF approved for food contact.
 - 6. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - 7. Color/Pattern Family: Refer to ID Finish Schedule/Legend.
 - 8. Other Components Thickness: 1/2 inch (12 mm), minimum.
 - 9. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
 - 10. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.

2.4 MATERIALS

- A. Adhesives and Joint Fillers: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined; color as selected by fabricator to blend with primary surface color to conceal appearance of joint.
- B. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch (12 mm) by 1/2 inch (12 mm).
- C. Joint Sealant: Mildew-resistant silicone sealant, clear color.
- D. Sealer: Stain and acid protection for natural stone counters.
 - 1. NSF approved for food contact per NSF 51.

2.5 ACCESSORIES

- A. Countertop Support Brackets:
 - 1. Material: Tempered, fabricated steel brackets designed for surface or flush mounting as indicated; sizes and configurations as indicated.
 - 2. Size: 18 by 24 inches (915 by 1219 mm).
 - 3. Load: 1000 lb.
 - 4. Finish: Manufacturer's standard, black powder coat finish.
 - 5. Acceptable Product:

- a. A & M Hardware, Inc.; Work Station Brackets: www.aandmhardware.com.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

2.6 FABRICATION

- A. General: Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to walls with contact surfaces set in waterproof adhesive.
 - 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Natural Stone Countertops: Fabricate tops in largest practical pieces as determined by slab size and orientation of natural features; join pieces with adhesive sealant and joint filler in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 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.

3.3 INSTALLATION

- A. Install vanities in accordance with manufacturer's instructions, and as detailed on Drawings.
- B. Install with inconspicuous, hairline joints.
- C. Install countertop support brackets securely to wall blocking; see Section 06 10 00 for additional requirements.
- D. Do not cut stone in field. If stone countertops or splashes require additional fabrication not specified to be performed at Project site, return to fabrication shop for adjustment.
- E. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- F. Securely attach countertop brackets to structural framing as detailed on Drawings; securely attach countertops to brackets using concealed fasteners.
- G. Seal joint between back/end splashes and vertical surfaces.
 - 1. Where indicated use rubber cove molding.
 - 2. Where applied cove molding is not indicated use specified sealant.
- H. Stone Sealer: Apply stone sealer in accordance with stone producer's and sealer manufacturer's instructions.

3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum, noncumulative.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.
- D. Variation in Plane Between Adjacent Pieces at Joint: Plus or minus 1/64 inch.

3.5 CLEANING

- A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, **24 gauge** minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:

1. Description: Manufactured steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

1. Description: Manufactured, Dura-coated or Duco-coated, or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:

1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - a. Hydrostatic Seal: **20 psig** minimum.
 - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 - c. Pressure Plates: Carbon steel or Composite plastic.
 - d. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating of length required to secure pressure plates to sealing elements.

E. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, 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. Escutcheon Types:

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 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, and, exposed-rivet hinge; and spring-clip fasteners.

B. Floor Plates:

1. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

3.2 INSTALLATION OF SLEEVES, GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. 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.

3.3 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop 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 centered across width centered in concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout, seal space around outside of sleeves.

3.4 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing.
 - 2. Install section of cast-iron soil pipe to extend sleeve to **3 inches** above finished floor level.
 - 3. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials.

3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

3.6 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.7 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks

and retest until no leaks exist.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops, or, stack-sleeve fittings.
4. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

3.9 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel, or split plate steel with polished, chrome-plated finish.
3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated finish.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, stainless steel with polished stainless steel finish.
6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, steel with polished, chrome-plated finish.

- 7. Bare Piping in Equipment Rooms:
 - a. One piece, steel with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment room floors.
- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 - 2. Existing Piping: Split floor plate.

END OF SECTION

SECTION 21 10 00

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of **175 psig** maximum.
- B. High-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure higher than standard **175 psig**, but not higher than 250 psig.

1.2 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Prepare in accordance with NFPA 13 section "Working Plans."
 - a. Include plans, elevations, and sections of the system piping and details.
 - b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
 - c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Submit documents and calculations prepared by NICET Level III-certified technician, "Water-Based Systems Layout."
 - 3. Include diagrams for power, signal, and control wiring.
- B. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, prepared by NICET Level III-certified technician, "Water-Based Systems Layout."

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.4 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.
 - 2. System control valves.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by NICET Level III-certified technician, "Water-Based Systems Layout."

1.6 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 in accordance with requirements indicated:
1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire-suppression service.
 2. Do not proceed with interruption of fire-suppression service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Automatic wet-pipe sprinkler system.
- B. Automatic dry-pipe sprinkler.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."
- 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. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13, or NFPA 13R as applicable to the building occupancy.
- D. Standard-Pressure Piping System Component: Listed for **175 psig** minimum working pressure.
- E. High-Pressure Piping System Component: Listed for 250 psig minimum working pressure.
- F. Delegated Design: Engage a NICET Level III-certified technician, "Water-Based Systems Layout" to design fire-suppression systems.
 1. Maximum protection area per sprinkler in accordance with UL listing.
- G. Obtain documented approval of fire-suppression system design from AHJs.

2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.
 - b. Factory-applied exterior coating.
 - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
2. Schedule 10 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.
 - b. Factory-applied exterior coating.
 - c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
3. Steel Pipe Nipples: black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
4. Steel Couplings: Galvanized, and, uncoated steel, ASTM A865/A865M, threaded.
5. Gray-Iron Threaded Fittings: Galvanized, and, uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
6. Malleable- or Ductile-Iron Unions: ASME B16.3.
7. Cast-Iron Flanges: ASME B16.1, Class 125.
8. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick, ASME B16.21, nonmetallic and asbestos free, or, EPDM rubber gasket.
 - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.
9. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
 - a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
10. Grooved-Joint, Steel-Pipe Appurtenances:
 - a. Pressure Rating: 175 psig minimum.
 - b. Grooved-End Fittings for Steel Piping: Painted grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel

- pipe.
 - c. 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.
11. Carbon Steel Pressure-Seal Fittings: UL 213, FM Approvals-approved, **175 psig** pressure rating with carbon steel-, zinc-nickel-coated housing, EDPM O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
- B. CPVC Pipe, Fittings, and Appurtenances:
- 1. CPVC Pipe: ASTM F442/F442M and UL 1821, SDR 13.5, for **175 psig** rated pressure at **150 deg F**, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
 - 2. CPVC Fittings: UL listed, or, FM Approvals approved, for **175 psig** rated pressure at **150 deg F**, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
 - a. NPS 3/4 to NPS 1-1/2 (DN 20 to DN 40): ASTM F438 and UL 1821, Schedule 40, socket type.
 - b. NPS 2 to NPS 3 (DN 50 to DN 80): ASTM F439 and UL 1821, Schedule 80, socket type.
 - c. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
 - d. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
 - e. Flanges: CPVC, one or two pieces.
 - 3. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493 solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
 - 4. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 FIRE DEPARTMENT CONNECTIONS

- A. Fire Department Connection, Exposed Type:
- 1. Standard: UL 405.
 - 2. Description: Exposed, projecting, for wall mounting.
 - 3. Pressure Rating: **175 psig** minimum.
 - 4. Body Material: Corrosion-resistant metal.
 - 5. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - 6. Caps: Brass, lugged type, with gasket and chain.
 - 7. Escutcheon Plate: Round, brass, wall type.
 - 8. Outlet: Back, with pipe threads.
 - 9. Number of Inlets: Two.
 - 10. Escutcheon Plate Marking: "AUTO SPKR".
 - 11. Finish: Rough brass or bronze.
 - 12. Outlet Size: NPS 4 to be verified with AHJ.
- B. Fire Department Connection, Flush Type:
- 1. Standard: UL 405.
 - 2. Description: Flush, for wall mounting.
 - 3. Pressure Rating: **175 psig** minimum.
 - 4. Body Material: Corrosion-resistant metal.
 - 5. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices

- or clappers.
- 6. Caps: Brass, lugged type, with gasket and chain.
- 7. Escutcheon Plate: Rectangular, brass, wall type.
- 8. Outlet: With pipe threads.
- 9. Body Style: Horizontal or as required by AHJ.
- 10. Number of Inlets: Two or as required by AHJ.
- 11. Outlet Location: Back or as required by AHJ.
- 12. Escutcheon Plate Marking: "AUTO SPKR".
- 13. Finish: Rough brass or bronze.
- 14. Outlet Size: NPS 4 or as required by AHJ.

C. Fire Department Connection, Yard Type:

- 1. Standard: UL 405.
- 2. Description: Exposed, freestanding.
- 3. Pressure Rating: 175 psig minimum.
- 4. Body Material: Corrosion-resistant metal.
- 5. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- 6. Caps: Brass, lugged type, with gasket and chain.
- 7. Escutcheon Plate: Round, brass, floor type.
- 8. Outlet: Bottom, with pipe threads.
- 9. Number of Inlets: Two or as required by AHJ.
- 10. Sleeve: Brass.
- 11. Sleeve Height: **18 inches**.
- 12. Escutcheon Plate Marking: "AUTO SPKR".
- 13. Finish, Including Sleeve: Rough brass or bronze.
- 14. Outlet Size: NPS 4 or as required by AHJ.

2.5 SYSTEM CONTROL VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

B. Pressure Rating:

- 1. Standard-Pressure Piping Valves: **175 psig** minimum.
- 2. High-Pressure Piping Valves: 250 psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. System Control Valve, Dry-Pipe Valve:

- 1. Standards:
 - a. UL 260.
 - b. UL 1486.
- 2. Design: Differential-pressure type.
- 3. Include quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
- 4. Air Compressor for Dry-Pipe Valve:

- a. Motor Horsepower: Fractional.
- b. Power: 120 V ac, 60 Hz, single phase.
- c. Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA standards. Provide ASME air receiver tank as required to meet requirements on larger systems.
- d. Include filters, relief valves, coolers, automatic drains, and gauges.

2.6 FIRE-SUPPRESSION PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

D. Flexible Sprinkler Hose Fittings:

1. Standards:
 - a. UL 2443.
 - b. FM 1637.
2. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175 psig minimum.
4. Size: Same as connected piping, for sprinkler.

E. Automatic Air Vent:

1. Description: Automatic air vent that automatically vents trapped air without human intervention. Approved for use in wet-pipe fire-suppression system.
2. Vents oxygen continuously from system.
3. Float valve to prevent water discharge.
4. Minimum Water Working Pressure Rating: **175 psig**.

2.7 SPRINKLERS

A. Standards:

1. UL 199.
2. UL 1767.
3. UL 1626.
4. FM 2000.
5. FM 2008.
6. FM 2030.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

C. Pressure Rating for Sprinklers:

1. Standard Automatic Sprinklers: **175 psig** minimum.

D. Sprinklers, Automatic Wet with Heat-Responsive Element:

1. 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.
2. Standard Spray, Standard Response:
 - a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, concealed pendent.
 - e. Vertical sidewall.
 - f. Horizontal sidewall.
3. Standard Spray, Quick Response:
 - a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, concealed pendent.
 - e. Vertical sidewall.
 - f. Horizontal sidewall.
 - g. Flat, concealed horizontal sidewall.
4. Extended Coverage:
 - a. Upright.
 - b. Pendent.
 - c. Flat, concealed pendent.
 - d. Horizontal sidewall.
 - e. Flat, concealed horizontal sidewall.
5. Residential:
 - a. Recessed pendent.
 - b. Flat, concealed pendent.
 - c. Flat, concealed horizontal sidewall.

E. Sprinklers, Automatic Dry with Heat-Responsive Element:

1. Standard Spray, Standard Response:

- a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, concealed pendent.
 - e. Horizontal sidewall.
 - 2. Standard Spray, Quick Response:
 - a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, Concealed pendent.
 - e. Horizontal sidewall.
 - f. Flat, concealed horizontal sidewall.
 - F. Special Sprinklers:
 - 1. Attic.
 - 2. Combustible, concealed.
 - 3. ESFR.
 - 4. Flat spray.
 - 5. Hallway.
 - 6. Institutional.
 - 7. MRI/Non-Ferrous, concealed.
 - 8. Window.
 - G. Open Sprinklers and Nozzles:
 - 1. Nominal Orifice:
 - a. **1/2 inch**, with discharge coefficient K between 5.3 and 5.8.
 - b. **17/32 inch** with discharge coefficient K between 7.4 and 8.2.
 - H. Sprinkler Finishes: Chrome plated to be verified with Architect.
 - I. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Plastic, white finish, two piece, flat.
 - 2. Sidewall Mounting: Plastic, white finish, two piece, flat.
 - J. Sprinkler Guards and Water Shields:
 - 1. Standard: UL 199.
 - 2. Description: Wire cage with fastening device for attaching to sprinkler.
- 2.8 ALARM DEVICES
- A. Match alarm-device material and connection types to piping and equipment materials and connection types.
 - B. Electrically Operated Notification Appliances:
 - 1. Electric Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.

- c. Size: 6-inch minimum- diameter.
 - d. Voltage: 120 V ac, 60 Hz, single phase, or 24 V dc.
 - e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
- 2. Strobe/Horn:
 - a. Standard: UL 464.
 - b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
 - c. Voltage: 120 V ac, 60 Hz.
 - d. Effective Intensity: 110 cd.
 - e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
- C. Water-Flow Indicators:
 - 1. Standard: UL 346.
 - 2. Water-Flow Detector: Electrically supervised.
 - 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 4. Type: Paddle operated.
 - 5. Pressure Rating: **250 psig**.
 - 6. Design Installation: Horizontal or vertical.
- D. Pressure Switches - Water-Flow Alarm Detection:
 - 1. Description: Electrically supervised, pressure-activated water-flow switch with retard feature.
 - 2. Components: Two single-pole, double-throw switches with normally closed contacts.
 - 3. Design Operation: Rising pressure to 6 psi, plus or minus 2 psi signals water flow.
 - 4. Adjustability: Each switch is to be independently adjustable.
 - 5. Wire Separation: Pressure switch to provide for separation of wiring to each switch connection to allow for low- and high-voltage connections to comply with NFPA 70, Article 760 requirements.
- E. Valve Supervisory Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised.
 - 3. Design: Signals that controlled valve is in other than fully open position.
 - 4. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
 - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 6. OS&Y Valve Supervisory Switches:
 - a. One or two single-pole, double-throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
 - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
 - d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.
 - e. Trip Rod Length: Adjustable
 - 7. Butterfly Valve Supervisory Switches:
 - a. Two single-pole, double-throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.

- c. Mounting Hardware: Removable nipple.
 - d. Trip Rod Length: Adjustable
- 8. Ball Valve Supervisory Switches:
 - a. One single-pole, double-throw switch.
 - b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
 - c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves, or backflow preventers sized from up to **NPS 2**.

2.9 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: **3-1/2- to 4-1/2-inch** diameter.
- C. Pressure Gauge Range: 0 to 300 psig.
- D. Water System Piping Gauge: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
 - 1. Flow test is to be performed to meet the criteria established by NFPA 13, and, NFPA 14.
 - 2. Flow test is to be conducted in accordance with NFPA 291.
 - 3. Test is to be performed during a period of ordinary demand for the water system.
 - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
 - 4. Pitot readings are to be taken at the **2-1/2-inch** orifice connection.
 - 5. The pitot reading is to range from **10 to 35 psig**.
 - 6. Open additional hydrant outlets as needed to control pitot readings.
 - 7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.
- B. Flow Test Data Written Report:
 - 1. Flow data report is to be written in accordance with NFPA 291.
 - 2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.
- C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.
- D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying

pressure gauges.

- E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION PIPING

- 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 AHJs. 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.
- B. Piping Standard: Comply with NFPA 13, and, NFPA 14 requirements for installation of fire-suppression piping.
- C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes **NPS 2** and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2** and larger end connections.
- F. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.
- G. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. 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 exterior of building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards.
- L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. Include pressure gauges with connection not less than **NPS 1/4** and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- M. Pressurize and check dry-pipe standpipe or sprinkler system piping and air compressors.
- N. Fill wet-type fire-suppression system piping with water.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. "
- P. Install sleeve seals for piping penetrations of concrete walls and slabs.

- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 INSTALLATION OF PIPING JOINTS

- 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. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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.
- G. Steel-Piping, Pressure-Sealed Joints: Join steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- H. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- L. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 2. CPVC Piping: Join in accordance with ASTM D2846/D2846M Appendix.

3.4 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

- A. Install wall-type fire department connections.

- B. Install yard-type fire department connections in concrete slab support.
- C. Install two protective pipe bollards on sides of each fire department connection.
- D. Install automatic (ball-drip) drain valve at each check valve for fire department connection.

3.5 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping in accordance with manufacturer's installation manual and in accordance with NFPA 13 or NFPA 13R for supports.

3.6 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
- B. Install listed fire-suppression system shutoff valves in supervised open position, 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. System Control Valves:
 - 1. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air-supply piping.
- D. Air Vent:
 - 1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
 - 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
 - 3. Pipe from outlet of air vent to drain.

3.7 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of narrow dimension of acoustical ceiling panels within tolerance of 1/2 inch. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
- B. Install dry-type sprinklers with water supply from heated space. 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.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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 fire-suppression systems in accordance with NFPA standards.
 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.
 9. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
- C. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
- D. Prepare test and inspection reports.

3.9 CLEANING

- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
- 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 system control valves, and, pressure-maintenance pumps, as applicable.

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. CPVC pipe, Schedule 40, or Schedule 80 CPVC fittings, and solvent-cemented joints may be used for light-hazard and residential occupancies.
- D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:
1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Schedule 40, black-steel pipe with cut-, or, roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 3. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- E. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:
1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and

- threaded joints.
 - 2. Schedule 40, black-steel pipe with cut-, or, roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 3. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- F. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:
- 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Schedule 40, black-steel pipe with cut-, or, roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - 6. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- G. High-Pressure, Wet-Pipe Sprinkler System, NPS 4 (DN 100) and Smaller, to Be One of the Following:
- 1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - 4. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.
- H. High-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:
- 1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Sleeves without waterstop.
3. Sleeves with waterstop.
4. Stack-sleeve fittings.
5. Sleeve-seal systems.
6. Grout.
7. Silicone sealants.
8. Escutcheons.
9. Thermometers, bimetallic actuated, lead free.
10. Thermometers, filled system, lead free.
11. Thermometers, liquid in glass, lead free.
12. Thermometers, light activated, lead free.
13. Thermowells, lead free.
14. Pressure gauges, dial type, lead free.
15. Gauge attachments, lead free.
16. Test plugs, lead free.
17. Test-plug kits, lead free.
18. Sight flow indicators, lead free.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications:** Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications:** Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.5 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 MOTORS

- A. Motor Requirements, General:
 - 1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
 - 2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
 - 3. Comply with NEMA MG 1 unless otherwise indicated.
 - 4. Comply with IEEE 841 for severe-duty motors.
- B. Motor Characteristics:
 - 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
 - 2. 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. Polyphase Motors:
 - 1. Description: NEMA MG 1, Design B, medium induction motor.
 - 2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
 - 3. Service Factor: 1.15.
 - 4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.

5. Multispeed Motors, Two Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:
 - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. 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.
2. Motors Used with Variable-Frequency Controllers:
 - a. 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.
 - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. 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 will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts [120 V] [or] [240 V] single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Building Automation System Interface (if applicable).

2.3 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Products & Systems, LLC
 - b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries
 - d. Metraflex Company (The)
2. Description: Manufactured PVC/HDPE, steel, stainless steel, or galvanized-steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Wade; a subsidiary of McWane Inc.
 - c. Zurn Industries, LLC
2. Description: Manufactured, Dura-coated, Duco-coated, or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Products & Systems, LLC
 - b. GPT; a division of EnPRO Industries
 - c. Metraflex Company (The)
 - d. Proco Products, Inc
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - a. Hydrostatic Seal: 20 psig minimum.
 - b. Sealing Elements: EPDM-rubber, High-temperature-silicone, or Nitrile (Buna-N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - c. Pressure Plates: Carbon steel, or Stainless steel.
 - d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 or Stainless steel of length required to secure pressure plates to sealing elements.

E. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, 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.

F. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) ITW Polymers Sealants North America
 - 3) Polymeric Systems, Inc
 - 4) Sherwin-Williams Company (The)
 - 5) Sika Corporation
 - 6) The Dow Chemical Company
 - 7) Tremco Incorporated
 - b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
2. Silicone Sealant, S, P, T, NT: Single-component, 25, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Pecora Corporation
 - 2) Sika Corporation
 - 3) The Dow Chemical Company
 - 4) Tremco Incorporated
 - b. Standard: ASTM C920, Type S, Grade P, [Class 25] [Class 100/50], Uses T and NT.
3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Smooth-On
4. Sealant shall have a VOC content of 250 > g/L or less.
 - a. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.4 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. BrassCraft Manufacturing Co.; a Masco company
2. Dearborn Brass
3. Jones Stephens Corp.

4. Keeney Manufacturing Company (The)
5. Mid-America Fittings, LLC; A Midland Industries Company
6. ProFlo; a Ferguson Enterprises, Inc. brand

B. Escutcheon Types:

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 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. Retain one or both finish options in "Split-Plate, Stamped-Steel Type" Subparagraph below that match escutcheon types retained in Part 3. Escutcheons described in subparagraph are generally available in 5/8-inch (15-mm) OD, 7/8-inch (22-mm) OD, 1-1/4-inch (32-mm) OD, 1-1/2-inch (38-mm) OD, 3/8-inch (9.5-mm) IPS, 1/2-inch (13-mm) IPS, 3/4-inch (19-mm) IPS, 1-inch (25-mm) IPS, 1-1/4-inch (32-mm) IPS, 1-1/2-inch (38-mm) IPS, and 2-inch (50-mm) IPS.
7. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; exposed-rivet hinge; and spring-clip fasteners.

C. Floor Plates:

1. Split Floor Plates: Cast brass with concealed hinge.

2.5 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Bimetallic Actuated, Lead Free:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ashcroft Inc
 - b. Blue Ribbon Corp.
 - c. Ernst Flow Industries
 - d. Marsh Bellofram
 - e. Miljoco Corporation
 - f. Noshok
 - g. Palmer Wahl Instrumentation Group
 - h. REOTEMP Instrument Corporation
 - i. Tel-Tru Manufacturing Company
 - j. Terrice, H. O. Co
 - k. WATTS; A Watts Water Technologies Company
 - l. Weiss Instruments, Inc
 - m. Weksler Glass Thermometer Corp.
 - n. WIKA Instrument Corporation
 - o. Winters Instruments - U.S.
2. Source Limitations: Provide lead-free bimetallic-actuated thermometers from a single manufacturer.
3. Standard: ASME B40.200.
4. Case: Liquid-filled and sealed type(s); stainless steel.
5. Dial: [Nonreflective aluminum] <Insert material> with permanent scale markings and scales in deg F.
6. Connector Type(s): Union joint; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
7. Stem: stainless steel or lead-free brass.
8. Ring: Stainless steel.
9. Element: Bimetal coil.
10. Pointer: Dark-colored metal.
11. Accuracy: Plus or minus 1 percent of span.

B. Thermometers, Filled System, Lead Free - Direct Mounted, Metal Case, Vapor Actuated:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ashcroft Inc
 - b. Miljoco Corporation
 - c. Palmer Wahl Instrumentation Group
 - d. EOTEMP Instrument Corporation
 - e. Terrice, H. O. Co
 - f. Weiss Instruments, Inc
2. Source Limitations: Provide filled-system, lead-free, direct-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
3. Standard: ASME B40.200.
4. Case: Sealed type, cast aluminum or drawn steel.
5. Element: Lead-free Bourdon tube.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F.
8. Pointer: Dark-colored metal.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
11. Thermal System: Liquid-filled, mercury-free bulb in copper-plated steel, aluminum, or lead-free brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of span.

C. Thermometers, Filled System, Lead Free - Direct Mounted, Plastic Case, Vapor Actuated:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. REOTEMP Instrument Corporation
2. Source Limitations: Provide filled-system, lead-free, direct-mounted, plastic-case, vapor-actuated thermometers from single manufacturer.
3. Standard: ASME B40.200.
4. Case: Sealed type.
5. Element: Lead-free Bourdon tube.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F.
8. Pointer: Dark-colored metal.
9. Connector Type(s): Union joint with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
10. Thermal System: Liquid-filled, mercury-free bulb in copper-plated steel or aluminum, or lead-free brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
11. Stem Length: To match thermowell insertion length.
12. Accuracy: Plus or minus 1 percent of span.

D. Thermometers, Filled System, Lead Free - Remote Mounted, Metal Case, Vapor Actuated:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Miljoco Corporation
 - b. Palmer Wahl Instrumentation Group
 - c. REOTEMP Instrument Corporation
 - d. Terrice, H. O. Co

- e. Weiss Instruments, Inc
 - f. WIKA Instrument Corporation
 - 2. Source Limitations: Provide filled-system, lead-free, remote-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
 - 3. Standard: ASME B40.200.
 - 4. Case: Sealed type, cast aluminum or drawn steel with flange and holes for panel mounting.
 - 5. Element: Lead-free Bourdon tube.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F.
 - 8. Pointer: Dark-colored metal.
 - 9. Ring: Stainless steel.
 - 10. Connector Type(s): Union joint with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 - 11. Thermal System: Liquid-filled, mercury-free, bulb in copper-plated steel, aluminum, or lead-free brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 12. Stem Length: To match thermowell insertion length.
 - 13. Accuracy: Plus or minus 1 percent of span.
- E. Thermometers, Filled System, Lead Free - Remote Mounted, Plastic Case, Vapor Actuated:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Miljoco Corporation
 - b. REOTEMP Instrument Corporation
 - 2. Source Limitations: Provide filled-system, lead-free, remote-mounted, plastic-case, vapor-actuated thermometers from a single manufacturer.
 - 3. Standard: ASME B40.200.
 - 4. Case: Sealed type with flange and holes for panel mounting.
 - 5. Element: Lead-free Bourdon tube.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F.
 - 8. Pointer: Dark-colored metal.
 - 9.
 - 10. Connector Type(s): Union joint, threaded, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 - 11. Thermal System: Liquid-filled, mercury-free bulb in copper-plated steel, aluminum, or lead-free brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 12. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- F. Thermometers, Liquid in Glass, Lead Free - Metal Case, Compact Style:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Miljoco Corporation
 - b. Terice, H. O. Co
 - 2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, compact-style thermometers by single manufacturer.
 - 3. Standard: ASME B40.200.
 - 4. Case: Cast aluminum.
 - 5. Tube: Glass with magnifying lens and blue organic liquid; mercury free.

6. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or lead-free brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
10. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

G. Thermometers, Liquid in Glass, Lead Free - Plastic Case, Compact Style:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Blue Ribbon Corp.
 - b. Flo Fab Inc
 - c. Miljoco Corporation
 - d. WATTS; A Watts Water Technologies Company
 - e. Weiss Instruments, Inc
 - f. Weksler Glass Thermometer Corp.
2. Source Limitations: Provide liquid-in-glass, lead-free, plastic-case, compact-style thermometers from single manufacturer.
3. Standard: ASME B40.200.
4. Tube: Glass with magnifying lens and blue[or red] organic liquid, mercury free.
5. Tube Background: Nonreflective with permanent scale markings graduated in deg F.
6. Window: Glass or plastic.
7. Stem: Aluminum or lead-free brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
8. Connector: 3/4 inch, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
9. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

H. Thermometers, Liquid in Glass, Lead Free - Metal Case, Industrial Style:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Blue Ribbon Corp.
 - b. Flo Fab Inc
 - c. Miljoco Corporation
 - d. Palmer Wahl Instrumentation Group
 - e. Trerice, H. O. Co
 - f. Weiss Instruments, Inc
 - g. Weksler Glass Thermometer Corp.
 - h. Winters Instruments - U.S.
2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, industrial-style thermometers from single manufacturer.
3. Standard: ASME B40.200.
4. Case: Cast aluminum.
5. Tube: Glass with magnifying lens and blue organic liquid, mercury free.
6. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
7. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
8. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

I. Thermometers, Liquid in Glass, Lead Free - Plastic Case, Industrial Style:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ernst Flow Industries
 - b. Marsh Bellofram
 - c. Miljoco Corporation
 - d. Palmer Wahl Instrumentation Group
 - e. WATTS; A Watts Water Technologies Company
 - f. Weiss Instruments, Inc
 - g. Weksler Glass Thermometer Corp.
 - h. Winters Instruments - U.S.
 2. Source Limitations: Provide liquid-in-glass, lead-free, plastic-case, industrial-style thermometers from single manufacturer.
 3. Standard: ASME B40.200.
 4. Tube: Glass with magnifying lens and blue organic liquid, mercury free.
 5. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
 6. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 7. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- J. Thermometers, Light Activated, Lead Free - Direct Mounted:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Miljoco Corporation
 - b. Terice, H. O. Co
 - c. Weiss Instruments, Inc
 - d. Weksler Glass Thermometer Corp.
 - e. Winters Instruments - U.S.
 2. Source Limitations: Provide light-activated, lead-free, direct-mounted thermometers from single manufacturer.
 3. Scale Divisions: Deg F.
 4. Connector: 1-1/4 inches , with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 5. Display: Digital.
 6. Accuracy: Plus or minus 1 deg F.
- K. Thermometers, Light Activated, Lead Free - Remote Mounted:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Miljoco Corporation
 2. Source Limitations: Provide light-activated, lead-free, remote-mounted thermometers from single manufacturer.
 3. Case: Plastic, for wall mounting.
 4. Scale Divisions: Deg F.
 5. Sensor: Lead-free bulb and thermistor wire.
 - a. Design for Thermowell Installation: Bare stem.
 6. Display: Digital.
 7. Accuracy: Plus or minus 1 deg F.
- L. Thermowells, Lead Free:
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: Lead-free copper <Insert material>.

4. Material for Use with Steel Piping: Stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
7. Internal Threads: Size and thread type as required to match thermometer mounting threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length to extend a minimum of 2 inches into fluid.
10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
12. Heat-Transfer Medium: Mixture of graphite and glycerin.

M. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ametek U.S. Gauge
 - b. Ashcroft Inc
 - c. Blue Ribbon Corp.
 - d. Ernst Flow Industries
 - e. Flo Fab Inc
 - f. Marsh Bellofram
 - g. Miljoco Corporation
 - h. Noshok
 - i. Palmer Wahl Instrumentation Group
 - j. REOTEMP Instrument Corporation
 - k. Tel-Tru Manufacturing Company
 - l. Terrice, H. O. Co
 - m. WATTS; A Watts Water Technologies Company
 - n. Weiss Instruments, Inc
 - o. Weksler Glass Thermometer Corp.
 - p. WIKA Instrument Corporation
 - q. Winters Instruments - U.S.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Pressure-Element Assembly: Lead-free Bourdon tube.
5. Pressure Connection: Lead-free brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

N. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Plastic Case:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ametek U.S. Gauge
 - b. Ashcroft Inc
 - c. Flo Fab Inc
 - d. Marsh Bellofram
 - e. Miljoco Corporation
 - f. Noshok
 - g. Palmer Wahl Instrumentation Group
 - h. REOTEMP Instrument Corporation
 - i. Tel-Tru Manufacturing Company
 - j. Terrice, H. O. Co
 - k. Weiss Instruments, Inc

- I. Weksler Glass Thermometer Corp.
 - m. WIKA Instrument Corporation
 - n. Winters Instruments - U.S.
 - 2. Source Limitations: Provide dial-type, lead-free, direct-mounted, plastic-case pressure gauges from a single manufacturer.
 - 3. Standard: ASME B40.100.
 - 4. Pressure-Element Assembly: Lead-free Bourdon tube.
 - 5. Pressure Connection: Lead-free brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
 - 8. Pointer: Dark-colored metal.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- O. Pressure Gauges, Dial Type, Lead Free - Remote Mounted, Metal Case:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ametek U.S. Gauge
 - b. Ashcroft Inc
 - c. Ernst Flow Industries
 - d. Flo Fab Inc
 - e. Marsh Bellofram
 - f. Miljoco Corporation
 - g. Noshok
 - h. Palmer Wahl Instrumentation Group
 - i. REOTEMP Instrument Corporation
 - j. Tel-Tru Manufacturing Company
 - k. Trerice, H. O. Co
 - l. WATTS; A Watts Water Technologies Company
 - m. Weiss Instruments, Inc
 - n. WIKA Instrument Corporation
 - o. Winters Instruments - U.S.
 - 2. Source Limitations: Provide dial-type, lead-free, remote-mounted, metal-case pressure gauges from a single manufacturer.
 - 3. Standard: ASME B40.100.
 - 4. Pressure-Element Assembly: Lead-free Bourdon tube.
 - 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 6. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
 - 7. Pointer: Dark-colored metal.
 - 8. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- P. Pressure Gauges, Dial Type, Lead Free - Remote Mounted, Plastic Case:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ashcroft Inc
 - b. Flo Fab Inc
 - c. Miljoco Corporation
 - d. Noshok
 - e. Palmer Wahl Instrumentation Group
 - f. REOTEMP Instrument Corporation
 - g. Tel-Tru Manufacturing Company
 - h. Trerice, H. O. Co
 - i. Weiss Instruments, Inc
 - j. WIKA Instrument Corporation
 - 2. Source Limitations: Provide dial-type, lead-free, remote-mounted, plastic-case pressure gauges

- from single manufacturer.
- 3. Standard: ASME B40.100.
- 4. Pressure-Element Assembly: Lead-free Bourdon tube.
- 5. Movement: Mechanical, with link to pressure element and connection to pointer.
- 6. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
- 7. Pointer: Dark-colored metal.
- 8. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

Q. Gauge Attachments, Lead Free:

- 1. Snubbers: ASME B40.100, lead-free brass; with ASME B1.20.1 pipe threads and [piston] [porous-metal]-type surge-dampening device. Include extension for use on insulated piping.
- 2. Valves: Lead-free brass ball or Lead-free brass or stainless steel needle, with ASME B1.20.1 pipe threads.

R. Test Plugs, Lead Free:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. IMI Flow Design, Inc.
 - b. Miljoco Corporation
 - c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control
 - d. Peterson Equipment Co., Inc
 - e. Terice, H. O. Co
 - f. WATTS; A Watts Water Technologies Company
 - g. Weiss Instruments, Inc
 - h. Weksler Glass Thermometer Corp.
- 2. Source Limitations: Provide lead-free test plugs from single manufacturer.
- 3. Description: Test-station fitting made for insertion into piping tee fitting.
- 4. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- 5. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- 6. Core Inserts: Chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber.

S. Test-Plug Kits, Lead Free:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Blue Ribbon Corp.
 - b. Peterson Equipment Co., Inc
- 2. Source Limitations: Provide lead-free test-plug kits from single manufacturer.
- 3. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes are to be of diameter to fit test plugs and of length to project into piping.
- 4. Low-Range Thermometer, Lead Free: Small, bimetallic insertion type with tapered-end sensing element. Dial range is to be at least 25 to 125 deg F.
- 5. High-Range Thermometer, Lead Free: Small, bimetallic insertion type with tapered-end sensing element. Dial range is to be at least 0 to 220 deg F.
- 6. Pressure Gauge, Lead Free: Small, lead-free Bourdon-tube insertion type with probe. Dial range is to be at least 0 to 200 psig.
- 7. Carrying Case: Metal or plastic, with formed instrument padding.

T. Sight Flow Indicators, Lead Free:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ARCHON Industries, Inc

- b. Dwyer Instruments, Inc
 - c. Ernst Flow Industries
 - d. John C. Ernst Co., Inc.
 - e. KOBOLD Instruments, Inc. - USA
 - f. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company
- 2. Source Limitations: Provide lead-free sight flow indicators from single manufacturer.
 - 3. Description: Piping inline-installation device for visual verification of flow.
 - 4. Construction: Lead-free bronze or stainless steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
 - 5. Minimum Pressure Rating: 125 psig.
 - 6. Minimum Temperature Rating: 200 deg F.
 - 7. End Connections: Threaded or flanged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 2-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. 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 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop 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 centered across width of concrete slab or wall.

- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.3 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

3.5 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.6 INSTALLATION OF METERS AND GAUGES

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.

- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.
- H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- I. Install remote-mounted pressure gauges on panel.
- J. Install valve and snubber in piping for each pressure gauge for fluids.
- K. Install test plugs in piping tees.
- L. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
 - 5. Outlet side of hot-water-balancing valve.
 - 6. Each main hot-water-recirculating line return pipe.
- M. Install pressure gauges 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.

3.7 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.8 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.9 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. 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.
 - 2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.10 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops or stack-sleeve fittings.
4. Interior Wall and Partitions:
 - a. Sleeves without waterstops.

3.11 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel, cast brass, or split-casting brass with polished, chrome-plated finish.
3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, stainless steel with polished stainless steel finish.
 - c. One piece, cast brass with polished, chrome-plated finish.
 - d. One piece, stamped steel or split plate, stamped steel with polished, chrome-plated finish.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, stainless steel with polished stainless steel finish.
 - c. One piece, cast brass with polished, chrome-plated finish.
 - d. One piece, stamped steel or split plate, stamped steel with polished, chrome-plated finish.
5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, stainless steel with polished stainless steel finish.

- c. One piece, cast brass with polished, chrome-plated finish.
 - d. One piece, stamped steel or split plate, stamped steel with polished, chrome-plated finish.
 - 6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, cast brass with polished, chrome-plated finish.
 - c. One piece, stamped steel or split plate, stamped steel with polished, chrome-plated finish.
 - 7. Bare Piping in Equipment Rooms:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, cast brass with polished, chrome-plated finish.
 - c. One piece, stamped steel or split plate, stamped steel with polished, chrome-plated finish.
 - B. Escutcheons for Existing Piping to Remain:
 - 1. Chrome-Plated Piping: Split casting, stamped steel with hinge with polished, chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with hinge with polished, chrome-plated finish
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with hinge with polished, chrome-plated finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with hinge with polished, chrome-plated finish.
 - 5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with hinge with polished, chrome-plated finish.
 - 6. Bare Piping in Equipment Rooms: Split plate, stamped steel with hinge with polished, chrome-plated finish.
 - C. Install floor plates for piping penetrations of equipment-room floors.
 - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 - 2. Existing Piping: Split floor plate.
- 3.12 THERMOMETER, LEAD FREE, APPLICATION
- A. Thermometers at inlet and outlet of each domestic water heater are to be the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Direct or Remote-mounted, vapor-actuated type.
 - 3. Liquid-in-glass type.
 - 4. Light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
 - B. Thermometers at inlets and outlets of each domestic water heat exchanger are to be the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Direct or Remote-mounted, vapor-actuated type.
 - 3. Liquid-in-glass type.
 - 4. Light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
 - C. Thermometers at inlet and outlet of each domestic hot-water storage tank are to be the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.

2. Direct or Remote-mounted, vapor-actuated type.
3. Liquid-in-glass type.
4. Light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each remote domestic water chiller are to be the following:

1. Liquid-filled or Sealed, bimetallic-actuated type.
2. Direct or Remote-mounted, vapor-actuated type.
3. Liquid-in-glass type.
4. Light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

E. Thermometer stems are to be of length to match thermowell insertion length.

3.13 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

A. Scale Range for Domestic Cold-Water Piping:

1. 0 to 100 deg F.
2. 0 to 150 deg F.
3. 30 to 240 deg F.

B. Scale Range for Domestic Hot-Water Piping:

1. 0 to 250 deg F.
2. 20 to 240 deg F.
3. 30 to 240 deg F.

C. Scale Range for Domestic Cooled-Water Piping:

1. 0 to 100 deg F.
2. 0 to 150 deg F.

D. Insert additional paragraphs for thermometer scale ranges and applications.

3.14 PRESSURE-GAUGE APPLICATION

A. Pressure gauges at discharge of each water service into building are to be the following:

1. Liquid filled, Sealed, Open front, pressure relief, or Solid front, pressure relief
2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Pressure gauges at inlet and outlet of each water pressure-reducing valve are to be the following:

1. Liquid filled, Sealed, Open front, pressure relief, or Solid front, pressure relief
2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Pressure gauges at suction and discharge of each domestic water pump are to be the following:

1. Liquid filled, Sealed, Open front, pressure relief, or Solid front, pressure relief
2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

3.15 PRESSURE-GAUGE SCALE-RANGE APPLICATION

A. Scale Range for Water Service Piping:

1. 0 to 100 psi.
2. 0 to 160 psi.
3. 0 to 200 psi.

B. Scale Range for Domestic Water Piping:

1. 0 to 100 psi.
2. 0 to 160 psi.
3. 0 to 200 psi.
4. 0 to 300 psi.

C. Insert additional paragraphs for pressure-gauge scale ranges and applications.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Check valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. FKM: Fluoroelastomer.
- D. NBR: Nitrile butadiene rubber (also known as Buna-N).
- E. NRS: Nonrising stem.
- F. OS&Y: Outside screw and yoke.
- G. PTFE: Polytetrafluoroethylene.
- H. RPTFE: Reinforced polytetrafluoroethylene.
- I. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include material descriptions and dimensions of individual components.
 - b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.

5. Block check valves in either closed or open position.
 6. Set gate valves closed to prevent rattling.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
 2. ASME B16.1 for flanges on iron valves.
 3. ASME B16.5 for flanges on steel valves.
 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 5. ASME B16.18 for cast-copper solder-joint connections.
 6. ASME B16.22 for wrought-copper solder-joint connections.
 7. ASME B16.34 for flanged- and threaded-end connections.
 8. ASME B16.51 for press joint connections.
 9. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.
- H. Valve Actuator Type:
1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
 2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.
- I. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.2 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Bonomi North America, Inc.
 - c. Center Line; a Crane Co. brand
 - d. Hammond Valve
 - e. Jenkins Valves; a Crane Co. brand
 - f. Milwaukee Valve Company
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - i. Stockham; a Crane Co. brand
 - j. Viega LLC
 - k. WATTS; A Watts Water Technologies Company
 - l. Zurn Industries, LLC
2. Standards: MSS SP-110 and MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Bronze or brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

B. Ball Valves, Lead Free, Press Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Center Line; a Crane Co. brand
 - c. Hammond Valve
 - d. Milwaukee Valve Company
 - e. NIBCO INC.
 - f. Red-White Valve Corp.
 - g. Stockham; a Crane Co. brand
 - h. Viega LLC
 - i. Zurn Industries, LLC
2. Standards: MSS SP-110, MSS SP-145, and IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RTPFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.

11. Port: Full.
12. O-Ring Seal: EPDM or NBR.

C. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Center Line; a Crane Co. brand
 - c. DynaQuip Controls
 - d. Hammond Valve
 - e. Jenkins Valves; a Crane Co. brand
 - f. Milwaukee Valve Company]
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - i. Stockham; a Crane Co. brand
 - j. Viega LLC
 - k. WATTS; A Watts Water Technologies Company
2. Standards: MSS SP-110 and MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

D. Ball Valves - CPVC, Union Type:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Valve, Inc
 - b. Asahi/America
 - c. Colonial Engineering, Inc.
 - d. GF Piping Systems: Georg Fischer LLC
 - e. Hayward Flow Control; Hayward Industries, Inc.
 - f. IPEX USA LLC
 - g. Jomar Valve
 - h. Red-White Valve Corp.
 - i. Spears Manufacturing Company
 - j. Thermoplastic Valves, Inc
2. Standard: MSS SP-122.
3. Pressure Rating and Temperature: 125 psig, 150 psig, or other pressure at 73 deg F or other temperature. See Part 3 ball valve schedule articles.
4. Body Material: CPVC.
5. Body Design: Union type.
6. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 ball valve schedule articles.
7. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket, socket or threaded, threaded, or flanged. See Part 3 ball valve schedule articles.
8. Ball: CPVC, full port.
9. Seals: PTFE or EPDM-rubber O-rings.
10. Handle: Tee shaped.

E. Ball Valves - PVC, Union Type:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Valve, Inc
 - b. Asahi/America
 - c. Colonial Engineering, Inc.
 - d. GF Piping Systems: Georg Fischer LLC
 - e. Hayward Flow Control; Hayward Industries, Inc.
 - f. IPEX USA LLC
 - g. Jomar Valve
 - h. Red-White Valve Corp.
 - i. Spears Manufacturing Company
 - j. Thermoplastic Valves, Inc
2. Standard: MSS SP-122.
3. Pressure Rating and Temperature: 125 psig, 150 psig, or other pressure at 73 deg F or other temperature. See Part 3 ball valve schedule articles.
4. Body Material: PVC.
5. Body Design: Union type.
6. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 ball valve schedule articles.
7. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable union with socket, socket or threaded, threaded, or flanged. See Part 3 ball valve schedule articles.
8. Ball: PVC, full port.
9. Seals: PTFE or EPDM-rubber O-rings.
10. Handle: Tee shaped.

2.3 BALL VALVES, GENERAL PURPOSE

A. Ball Valves, Threaded Ends - Bronze, Two Piece, Safety Exhaust:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. DynaQuip Controls
 - c. Lance Valves
2. Standards: MSS SP-110 and MSS SP-145.
3. CWP Rating: 200 psig or other pressure. See Part 3 ball valve schedule articles.
4. Body Design: Two piece.
5. Body Material: Bronze, ASTM B584, Alloy C844.
6. Ends: Threaded.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
10. Port: Full.

B. Ball Valves, Threaded or Flanged Ends - Stainless Steel, Two Piece with Full Port:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. FNW; Ferguson Enterprises, Inc.
 - d. Hammond Valve
 - e. Jomar Valve
2. Standard: MSS SP-110.
3. CWP Rating: 200 psig.

4. Body Design: Split body.
5. Body Material: Type 316 stainless steel.
6. Ends: Threaded or flanged. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Type 316 stainless steel.
9. Ball: Type 316 stainless steel.
10. Port: Full.

2.4 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Crane Fluid Systems; Crane Co.
 - c. Jenkins Valves; a Crane Co. brand
 - d. Jomar Valve
 - e. Keckley Company
 - f. Lance Valves
 - g. Milwaukee Valve Company
 - h. NIBCO INC.
 - i. Red-White Valve Corp.
 - j. Shurjoint; a part of Aalberts Integrated Piping Systems
 - k. Stockham; a Crane Co. brand
 - l. Val-Matic Valve & Manufacturing Corp.
 - m. Victaulic Company
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: Bronze.

B. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Crane Fluid Systems; Crane Co.
 - c. Elkhart Products Corporation; a part of Aalberts Integrated Piping Systems
 - d. Hammond Valve
 - e. Milwaukee Valve Company
 - f. NIBCO INC.
2. Standards: MSS SP-80 and MSS SP-139.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B584, bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Disc: Brass or bronze.

C. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Anvil; an ASC Engineered Solution
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. ASC Engineered Solutions
 - d. Clow Valve Company; a subsidiary of McWane, Inc.
 - e. Cooper Valves
 - f. Crane Fluid Systems; Crane Co.
 - g. DeZURIK
 - h. GA Industries, Inc
 - i. Hammond Valve
 - j. Jenkins Valves; a Crane Co. brand
 - k. Jomar Valve
 - l. Kennedy Valve Company; a division of McWane, Inc.
 - m. KITZ Corporation
 - n. Lance Valves
 - o. Milwaukee Valve Company
 - p. Powell Valves
 - q. Victaulic Company
2. Standard: MSS SP-71, Type I.
 3. CWP Rating: 200 psig.
 4. Body Design: Clear or full waterway.
 5. Body Material: ASTM A126, gray iron with bolted bonnet.
 6. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
 7. Trim: Bronze.
 8. Gasket: Asbestos free.

D. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Lever- and Spring-Closure Control, Class 125:

Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following]
[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. [Apollo Valves; a part of Aalberts Integrated Piping Systems]
 - b. [Clow Valve Company; a subsidiary of McWane, Inc.]
 - c. [Cooper Valves]
 - d. [Crispin Valve]
 - e. [DeZURIK]
 - f. [GA Industries, Inc]
 - g. [Kennedy Valve Company; a division of McWane, Inc.]
 - h. <Insert manufacturer's name>
2. Standard: MSS SP-71, Type I.
3. CWP Rating: 200 psig.
4. Body Design: Clear or full waterway.
5. Body Material: ASTM A126, gray iron with bolted bonnet.
6. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
7. Trim: Bronze.
8. Gasket: Asbestos free.
9. Closure Control: Factory-installed exterior lever and weight.

E. Check Valves, Lead Free - CPVC, Union-Type Ball Check:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Valve, Inc
 - b. Asahi/America

- c. GF Piping Systems: Georg Fischer LLC
 - d. Hayward Flow Control; Hayward Industries, Inc.
 - e. IPEX USA LLC
 - f. NIBCO INC.
 - g. Spears Manufacturing Company
 - h. Thermoplastic Valves, Inc
 - 2. Pressure Rating and Temperature: 125 psig, 150 psig, or other pressure at 73 deg F or other temperature. See Part 3 check valve schedule articles.
 - 3. Body Material: CPVC.
 - 4. Body Design: Union-type ball check.
 - 5. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 check valve schedule articles.
 - 6. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket, socket or threaded, threaded, flanged. See Part 3 check valve schedule articles.
 - 7. Ball: CPVC.
 - 8. Seals: EPDM- or FKM-rubber O-rings.
- F. Check Valves, Lead Free - PVC, Union-Type Ball Check:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Valve, Inc
 - b. Asahi/America
 - c. GF Piping Systems: Georg Fischer LLC
 - d. Hayward Flow Control; Hayward Industries, Inc.
 - e. IPEX USA LLC
 - f. NIBCO INC.
 - g. Spears Manufacturing Company
 - h. Thermoplastic Valves, Inc
 - 2. Pressure Rating and Temperature: 125 psig, 150 psig, or other pressure at 73 deg F or other temperature. See Part 3 check valve schedule articles.
 - 3. Body Material: PVC.
 - 4. Body Design: Union-type ball check.
 - 5. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 check valve schedule articles.
 - 6. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket,, threaded, or flange.
 - 7. Ball: PVC.
 - 8. Seals: EPDM- or FKM-rubber O-rings.

2.5 CHECK VALVES, GENERAL PURPOSE

- A. Check Valves, Lift Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. American Valve, Inc
 - c. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - d. Crane Fluid Systems; Crane Co.
 - e. Flomatic Valves; Flomatic Corporation
 - f. Jenkins Valves; a Crane Co. brand
 - g. Jomar Valve
 - h. Keckley Company
 - i. Metraflex Company (The)
 - j. Milwaukee Valve Company

- k. NIBCO INC.
 - l. Stockham; a Crane Co. brand
 - m. Val-Matic Valve & Manufacturing Corp.
 - n. Victaulic Company
 - o. WATTS; A Watts Water Technologies Company
 - 2. Standard: MSS SP-80, Type 1.
 - 3. CWP Rating: 200 psig.
 - 4. Body Design: Vertical flow.
 - 5. Body Material: ASTM B61 or ASTM B62, bronze.
 - 6. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
 - 7. Disc: Bronze.
- B. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Crane Fluid Systems; Crane Co.
 - d. Hammond Valve
 - e. Jenkins Valves; a Crane Co. brand
 - f. Jomar Valve
 - g. Lance Valves
 - h. Legend Valve & Fitting, Inc
 - i. Milwaukee Valve Company
 - j. NIBCO INC.
 - k. Powell Valves
 - l. Red-White Valve Corp.
 - m. Stockham; a Crane Co. brand
 - 2. Standard: MSS SP-80, Type 3.
 - 3. CWP Rating: 300 psig.
 - 4. Body Design: Horizontal flow.
 - 5. Body Material: ASTM B62, bronze.
 - 6. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
 - 7. Disc: Bronze.
- C. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Spring-Closure Control, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Clow Valve Company; a subsidiary of McWane, Inc.
 - c. Cooper Valves
 - d. Crispin Valve
 - e. DeZURIK
 - f. GA Industries, Inc
 - g. Kennedy Valve Company; a division of McWane, Inc.
 - 2. Standard: MSS SP-71, Type I.
 - 3. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
 - 4. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
 - 5. Body Design: Clear or full waterway.
 - 6. Body Material: ASTM A126, gray iron with bolted bonnet.
 - 7. Ends: Flanged.
 - 8. Trim: Bronze.
 - 9. Gasket: Asbestos free.
 - 10. Closure Control: Factory-installed, exterior lever and spring.

- D. Check Valves, Dual-Plate Type - Iron, with Resilient Seat, Class 250:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jomar Valve
 - b. Keckley Company
 - c. Stockham; a Crane Co. brand
 - d. Sure Flow Equipment Inc
 - e. Val-Matic Valve & Manufacturing Corp.
 2. Standard: API 594.
 3. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 400 psig.
 4. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 300 psig.
 5. Body Design: Wafer, spring-loaded plates.
 6. Body Material: ASTM A126, gray iron.
 7. Seat: NBR.

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. Examine press fittings to verify they have been properly pressed.
- F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and actuator or manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.

- H. Chainwheels: Install chainwheels on manual operators for butterfly, globe, and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains 60 inches above finished floor.
- I. Install check valves for proper direction of flow and as follows:
 - 1. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
 - 2. Check Valves, Swing Type: In horizontal position with hinge pin level.
 - 3. Check Valves, Lift Type: With stem upright and plumb.
- J. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- K. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
 - 7. For Stainless Steel Piping, NPS 2 (DN 50) and Smaller: Threaded or Press ends.
 - 8. For Stainless Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.
 - 9. For Grooved-End Copper Tubing: Valve ends may be grooved.
 - 10. For Grooved-End Steel Piping: Valve ends may be grooved.
 - 11. Wafer-Type Valves: Flanged connections.

3.5 LOW-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Ball valves, threaded ends - bronze, two piece, safety exhaust; 200 psig.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Ball valves, threaded or flanged ends - stainless steel, two piece with full port.

3.6 HIGH-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, threaded ends - bronze, two piece, safety exhaust; 200 psig.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, flanged ends - stainless steel, two piece with full port.

3.7 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, lead free, threaded, soldered, or press ends - bronze, two piece with full port and bronze or brass trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, threaded or flanged ends - stainless steel, two piece with full port.

C. For CPVC Pipe:

1. CPVC Union-Type Ball Check Valve: NPS 4 and smaller 150 psig at 73 deg F .
 - a. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or threaded.
 - b. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded or Flanged.

D. For PVC Pipe:

1. PVC Union-Type Ball Check Valve: NPS 4 and smaller 150 psig at 73 deg F .
 - a. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or threaded.
 - b. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded or Flanged.

3.8 LOW-PRESSURE, COMPRESSED-AIR CHECK VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2 (DN 50) and Smaller:

1. Vertical, Upflow Applications Only:
 - a. Check valves, lift type, threaded or soldered ends - bronze, with bronze disc, Class 125.
2. Horizontal and Vertical Applications:
 - a. Check valves, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Check valves, swing type, flanged ends - iron, with metal seats, Class 125.

3.9 HIGH-PRESSURE, COMPRESSED-AIR CHECK VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Vertical, Upflow Applications Only:

- a. Check valves, lift type, threaded or soldered ends - bronze, with bronze disc, Class 125.

2. Horizontal and Vertical Applications:

- a. Check valves, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

- 1. Check valves, dual-plate type - iron, with resilient seat, Class 250.

3.10 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

- 1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125.
- 2. Check valves, lead free, swing type, press ends - bronze.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

- 1. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 125.

C. For CPVC Pipe:

- 1. NPS 2 (DN 50) and Smaller: Union ball valve.
- 2. NPS 4 (DN 100) and Smaller: Union ball valve.

D. For PVC Pipe:

- 1. NPS 2 (DN 50) and Smaller: Union ball valve.
- 2. NPS 4 (DN 100) and Smaller: Union ball valve.

3.11 PUMP-DISCHARGE CHECK VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

- 1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125.

B. Pipe NPS 2-1/2 (DN 65) and Larger for Domestic Water Pumps:

- 1. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and spring-closure control, Class 125.

C. Pipe NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage:

- 1. Check valves, swing type, flanged ends - iron, with lever- and spring-closure control, Class 125.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports - metal.
2. Pipe hangers - metal, trapeze type.
3. Pipe hangers - FRP.
4. Strut support systems - metal, rod type.
5. Strut support systems - FRP.
6. Thermal hanger-shield inserts.
7. Fastener systems.
8. Pipe-positioning systems.
9. Equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance:** Hangers and supports for plumbing piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with 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 PIPE HANGERS AND SUPPORTS - METAL

A. Pipe Hangers and Supports - Carbon Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. B-Line; a division of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.

2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
3. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
4. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
5. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

B. Pipe Hangers and Supports - Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by the following
2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

C. Pipe/Tube Hangers and Supports - Copper:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. B-Line; a division of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
2. Description: MSS SP-58, Types 1 through 58, copper-plated-steel, factory-fabricated components.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel or stainless steel.

2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

- 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 PIPE HANGERS - FRP

A. Pipe Hangers - FRP, Clevis Type:

1. Description: Similar to MSS SP-58, Type 1 factory-fabricated steel pipe hanger, except hanger is made of fiberglass-reinforced plastic resin.
2. Hanger Rods: Continuous-thread stainless steel rod, washer, and nuts made of FRP, polyurethane, or stainless steel.
3. Flammability: ASTM D635, ASTM E84, UL 94.

B. Pipe Hangers - FRP, Strap Type:

1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger, except hanger is made of fiberglass-reinforced plastic resin.
 - a. Flammability: ASTM D635, ASTM E84, UL 94.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.5 STRUT SUPPORT SYSTEMS - METAL, ROD TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ABB, Electrification Business
 2. Anvil; an ASC Engineered Solution
 3. Atkore Unistrut
 4. B-Line; a division of Eaton, Electrical Sector
 5. CADDY; brand of nVent Electrical plc
 6. Carpenter & Paterson, Inc
 7. Empire Industries, Inc.
 8. Flex-Strut Inc.
 9. G-Strut
 10. Haydon Corporation
 11. PHD Manufacturing, Inc
 12. Rocket Rack; Robroy Industries
 13. Wesanco/ZSi-Foster; an Ideal Tridon Group Company
- B. Description: Factory-fabricated pipe-support assembly, made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.
- C. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
- D. Struts: Continuous slotted carbon-steel, stainless steel, or extruded-aluminum channel with intumed lips or angle.
- E. Strut Width: Selected for applicable load criteria.
- F. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- G. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
- H. Metallic Coating: Electroplated zinc, Hot-dip galvanized, Gold (yellow zinc dichromate) galvanized.
- I. Paint Coating: Green epoxy, acrylic, or urethane.
- J. Plastic Coating: PVC.
1. Combination Coating: .

2.6 STRUT SUPPORT SYSTEMS - FRP

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Atkore Unistrut
 2. Champion Fiberglass, Inc
 3. G-Strut
 4. Seasafe, Inc.; AMICO, a Gibraltar Industries Company
- B. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.
1. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 2. Struts: Continuous slotted fiberglass-reinforced plastic channel with intumed lips.
 3. Strut Width: Selected for applicable load criteria.
 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
 6. Rated Strength: Selected to suit applicable load criteria.

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

2.7 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Aeroflex USA
 2. Buckaroos, Inc.
 3. Carpenter & Paterson, Inc
 4. KB Enterprise
 5. National Pipe Hanger Corporation
 6. Pipe Shields Inc.
 7. Piping Technology & Products, Inc
 8. Rilco Manufacturing Co., Inc
 9. Value Engineered Products, Inc
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psig or ASTM C591, 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 C533, Type I calcium silicate with 100 psig, ASTM C552, Type II cellular glass with 100 psig, or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

- A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC
- B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. B-Line; a division of Eaton, Electrical Sector
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC
 2. Indoor Applications: Zinc-plated or stainless steel.

3. Outdoor Applications: Stainless steel.

2.9 PIPE-POSITIONING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Holdrite; a division of Reliance Worldwide Corporation
- B. 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.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.11 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, 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 is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. 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.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.

- C. 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. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. 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.
- F. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
 - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- H. 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 in accordance with ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- J. Strut System Installation: Metal or FRP; arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

- K. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- L. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
 - 3. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
 - 4. Install fasteners in accordance with manufacturer's written instructions.
- M. 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.
- N. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- O. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- P. Equipment Support Installation:
 - 1. Fabricate from welded-structural-steel shapes.
 - 2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 - 3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
 - 4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup:
 - 1. 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.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 - 2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 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] [metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless steel pipe hangers, FRP pipe hangers and FRP strut systems and stainless steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes

- NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction 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.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment 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.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Warning tags.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Champion America
 - d. Craftmark Pipe Markers
 - e. emedco
 - f. Kolbi Pipe Marker Co.
 - g. LEM Products Inc.
 - h. Marking Services Inc.
 - i. Pipemarker.com; Brimar Industries, Inc.
 - j. Seton Identification Products; a Brady Corporation company
2. Material and Thickness: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or [anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Champion America

- d. Craftmark Pipe Markers
 - e. emedco
 - f. Kolbi Pipe Marker Co.
 - g. LEM Products Inc.
 - h. Marking Services Inc.
 - i. Pipemarket.com; Brimar Industries, Inc.
 - j. Seton Identification Products; a Brady Corporation company
 - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
 - 7. Fasteners: Stainless steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following
- 1. Brady Corporation
 - 2. Carlton Industries, LP
 - 3. Champion America
 - 4. Craftmark Pipe Markers
 - 5. emedco
 - 6. LEM Products Inc.
 - 7. Marking Services Inc.
 - 8. National Marker Company
 - 9. Pipemarket.com; Brimar Industries, Inc.
 - 10. Seton Identification Products; a Brady Corporation company
 - 11. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 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-tapping 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 NFPA 70E, 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 the following:

1. Brady Corporation
2. Craftmark Pipe Markers
3. National Marker Company
4. Pipemarket.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company

- 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.

2.4 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Brady Corporation
2. Champion America
3. Craftmark Pipe Markers
4. emedco
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Marking Services Inc.
8. Pipemarket.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company

- B. Description: 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, Reinforced grommet and wire or string].
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

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 plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green 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 are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes >.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 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.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Domestic chilled-water piping for drinking fountains.
 - 5. Sanitary waste piping exposed to freezing conditions.
 - 6. Storm-water piping exposed to freezing conditions.
 - 7. Roof drains and rainwater leaders.
 - 8. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.6 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Products do not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- C. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- D. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Owens Corning
 - 2. Preformed Pipe Insulation, Type II, Class 1: Unfaced.
 - 3. Preformed Pipe Insulation, Type II, Class 2: With factory-applied ASJ, ASJ-SSL, ASJ+, or PSK jacket.
 - 4. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
 - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Aeroflex USA
 - b. [Armaceil LLC
 - c. K-Flex USA
- G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Knauf Insulation
 - c. Manson Insulation Inc.
 - d. Owens Corning
 - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ, ASJ-SSL, ASJ+, or PSK jacket.
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
 - 2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ, ASJ-SSL, ASJ+, or PSK jacket.
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
- I. Phenolic: Fabricated pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Polyguard Products, Inc.
 - b. Resolco Inc.
 - 2. Pre-fabricated Pipe Insulation: Type III with factory-applied ASJ, ASJ+, or PSK jacket].
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armaceil LLC

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
- C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Foster Brand; H. B. Fuller
 - 2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. Foster Brand; H. B. Fuller
 - d. K-Flex USA
 - 2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
 - 4. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
 - 5. Wet Flash Point: Below 0 deg F.
 - 6. Service Temperature Range: 40 to 200 deg F.
- D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 2. Adhesive: As recommended by phenolic manufacturer and with a VOC content of 50 g/L or less.
 3. Adhesives and sealants shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- F. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Adhesives shall have a VOC content of 80 g/L or less.
 3. Adhesives and sealants shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation
 - d. Speedline Corporation
 - e. The Dow Chemical Company
 2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
 3. Adhesives and sealants shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
 - 1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
 - 2. Mastics shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Knauf Insulation
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation
 - 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 3. Service Temperature Range: 0 to plus 180 deg F.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 - 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 3. Service Temperature Range: 0 to 180 deg F.
- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Aeroflex USA
 - b. Childers Brand; H. B. Fuller Construction Products
 - c. Foster Brand; H. B. Fuller
 - 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Knauf Insulation

- d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation
- 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 - 3. Service Temperature Range: 0 to plus 180 deg F.

2.6 LAGGING ADHESIVES

- A. Lagging Adhesives: Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Vimasco Corporation
 - 2. Adhesive shall be as recommended by insulation manufacturer and shall have a VOC content of 50 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
 - 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 5. Service Temperature Range: 20 to plus 180 deg F.

2.7 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 - d. Owens Corning
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: [Minus 58 to plus 176 deg F] [Minus 100 to plus 300 deg F].
 - 4.
 - 5. Sealant shall have a VOC content of 420 g/L or less.
 - 6. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. FSK and Metal Jacket Flashing Sealants:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: Aluminum.
 5. Sealant shall have a VOC content of 420 g/L or less.
 6. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.8 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 C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
 5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. irex Manufacturing Inc.
 - b. Johns Manville; a Berkshire Hathaway company
 - c. P.I.C. Plastics, Inc.
 - d. Proto Corporation
 - e. Speedline Corporation
2. Adhesive: As recommended by jacket material manufacturer.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper, 3-mil- thick, heat-bonded polyethylene and kraft paper, or 3-mil- thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 3-mil- thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-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 A240/A240M.
 - a. Sheet and roll stock ready for shop or field sizing or 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, 3-mil- thick, heat-bonded polyethylene and kraft paper, or 3-mil- thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-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.

- E. 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 the following:
 - a. Owens Corning
 - b. Polyguard Products, Inc.
- F. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with aluminum-foil facing.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. MFM Building Products Corp.
 - b. Polyguard Products, Inc.
- G. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M
 - b. Foster Brand; H. B. Fuller
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
 3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
- B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Foster Brand; H. B. Fuller
 - b. Vimasco Corporation

2.11 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: 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 the following:

- a. Alpha Associates, Inc.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Aeroflex USA
 - c. Avery Dennison Corporation, Specialty Tapes Division
 - d. Ideal Tape Co., Inc., an American Biltrite Company
 - e. Knauf Insulation
 2. Width: 3 inches.
 3. Thickness: 11.5 mils .
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. M Industrial Adhesives and Tapes Division
 - b. Ideal Tape Co., Inc., an American Biltrite Company
 2. Width: 2 inches .
 3. Thickness: 6 mils .
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
2. Width: inches .
 3. Thickness: [3.7 mils .
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
2. Stainless Steel: ASTM A240/A240M; 0.015 inch thickwide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire Products
 - b. Johns Manville; a Berkshire Hathaway company
 - c. RPR Products, Inc.

2.14 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Buckaroos, Inc.
 - b. McGuire Manufacturing
 - c. MVG Molded Products
 - d. Plumberex Specialty Products, Inc.
 - e. ProFlo; a Ferguson Enterprises, Inc. brand
 - f. Truebro; IPS Corporation
 - g. 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, [rovide products by the following:

- a. ProFlo; a Ferguson Enterprises, Inc. brand
 - b. Truebro; IPS Corporation
 - c. 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 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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of 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, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- 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 attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and 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, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with 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.
- 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 in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal

- with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- 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. Installation conforms 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 that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
 4. For insulation with 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 prefabricated 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 that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
- 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 prefabricated sections of same material as that of 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 or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

- 1. Install prefabricated sections of cellular-glass insulation to valve body.
- 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

- 1. Install pipe insulation to outer diameter of pipe flange.
- 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of 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 sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
- 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 prefabricated valve covers manufactured of same material as that of pipe insulation when available.
- 2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 3. Install insulation to flanges as specified for flange insulation application.
- 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL 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 jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals, and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install prefabricated 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 that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing

- insulation.
- 3. Install insulation to flanges as specified for flange insulation application.
- 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below:
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.14 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1/2 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 1/2 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 3/4 inch thick.

2. NPS 1-1/2 and Larger: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 1 inch thick.
- C. Domestic Chilled Water (Potable):
 1. All Pipe Sizes: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 1 inch thick.
- D. Stormwater and Overflow:
 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 1 inch thick.
- E. Roof Drain and Overflow Drain Bodies:
 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 1 inch thick.
- F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 1. All Pipe Sizes: Insulation is of the following:
 - a. Flexible Elastomeric: 1/2 inchthick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
 - d. Polyolefin: 1/2 inch thick.
- G. Sanitary Waste Piping Where Heat Tracing Is Installed:
 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

- c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches thick.
 - d. Phenolic: 1-1/2 inches thick.
- H. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyolefin: 3/4 inch thick.
- I. Hot Service Drains:
 - 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
- J. Hot Service Vents:
 - 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
 - e. Phenolic: 2 inches thick.
 - f. Polyolefin: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
 - e. Phenolic: 2 inches thick.
 - f. Polyolefin: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
 - d. Phenolic: 2 inches thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

E. Hot Service Vents:

1. All Pipe Sizes: Insulation is of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.
- B. Chilled Water, All Sizes: Cellular glass, 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
- D. Piping, Exposed:
 1. PVC: 20 mils thick.
 2. Aluminum: 0.016 inch thick.
 3. Painted Aluminum: 0.016 inch thick.
 4. Stainless Steel: 0.010 inch thick.

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 40 mils thick.

2. Aluminum: 0.024 inch thick.

3. Stainless Steel: 0.016 inch thick.

3.20 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Ductile-iron pipe and fittings - domestic water.
3. PEX tube and fittings - domestic water.
4. PVC pipe and fittings - domestic water.
5. Piping joining materials - domestic water.
6. Encasement for piping.
7. Transition fittings - domestic water.
8. Dielectric fittings - domestic water.

1.2 ACTION SUBMITTALS

A. Product Data:

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:** Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.4 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 in accordance with requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances** intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type K; ASTM B88, Type L; and ASTM B88, Type M.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Cambridge-Lee Industries, LLC
- b. Cerro Flow Products, LLC
- c. Mueller Streamline Co.; a company of Mueller Industries

- B. Annealed-Temper Copper Tube: ASTM B88, Type K, ASTM B88, Type L, and ASTM B88, Type M.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Cambridge-Lee Industries, LLC
- b. Cerro Flow Products, LLC
- c. Mueller Streamline Co.; a company of Mueller Industries

- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Elkhart Products Corporation; a part of Aalberts Integrated Piping Systems
- b. Mueller Streamline Co.; a company of Mueller Industries
- c. NIBCO INC.

- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.

- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.

- G. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

- H. Copper-Tube, Mechanically Formed Tee Fitting - Domestic Water: For forming T-branch on copper water tube.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. T-DRILL Industries Inc

2. Description: Tee formed in copper tube in accordance with ASTM F2014.

- I. Grooved, Mechanical-Joint, Copper Tube Appurtenances - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Anvil; an ASC Engineered Solution
 - b. ASC Engineered Solutions
 - c. Shurjoint; a part of Aalberts Integrated Piping Systems
 - d. Victaulic Company
 2. Source Limitations: Obtain grooved, mechanical-joint copper tube appurtenances from single manufacturer.
 3. Grooved-End, Copper Fittings: ASTM B75/B75M copper tube or ASTM B584 bronze castings.
 4. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, EPDM-rubber gasket, UL classified per NSF 61 and NSF 372, and rated for minimum 180 deg F, for use with ferrous housing and steel bolts and nuts; 300 psig minimum CWP pressure rating.
 - J. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Conex Banninger - USA
 - c. Copper Press Brand; Merit Brass Company
 - d. Elkhart Brass Mfg. Co., Inc
 - e. FNW; Ferguson Enterprises, Inc.
 - f. Mueller Streamline Co.; a company of Mueller Industries
 - g. NIBCO INC.
 - h. Viega LLC
 2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
 3. Housing: Copper.
 4. O-Rings and Pipe Stops: EPDM.
 5. Tools: Manufacturer's special tools.
 6. Minimum 200 psig working-pressure rating at 250 deg F.
 - K. Copper-Tube, Push-on-Joint Fittings - Domestic Water:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Elkhart Products Corporation; a part of Aalberts Integrated Piping Systems
 - c. NIBCO INC.
 2. Source Limitations: Obtain copper-tube, push-on-joint fittings from single manufacturer.
 3. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.
- 2.4 DUCTILE-IRON PIPE AND FITTINGS - DOMESTIC WATER
- A. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
 - B. Appurtenances for Grooved-End, Ductile-Iron Pipe - Domestic Water:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. ASC Engineered Solutions

- c. Shurjoint; a part of Aalberts Integrated Piping Systems
 - d. Smith-Cooper International
 - e. Star Pipe Products
 - f. Victaulic Company
2. Source Limitations: Obtain appurtenances for grooved-end, ductile-iron pipe from single manufacturer.
3. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions that match pipe.
4. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
 - a. AWWA C606 for ductile-iron-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) NPS 14 to NPS 18 (DN 350 to DN 450): 250 psig.
 - 2) NPS 20 to NPS 46 (DN 500 to DN 900): 150 psig.

2.5 PEX TUBE AND FITTINGS - DOMESTIC WATER

A. PEX Tube - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. HeatLink Group Inc.
 - b. IPEX USA LLC
 - c. MrPex Systems Inc
 - d. NIBCO INC.
 - e. REHAU
 - f. SharkBite, A Division of Reliance Worldwide Corporation
 - g. Sioux Chief Manufacturing Company, Inc.
 - h. Uponor
 - i. Viega LLC
 - j. Warmboard, Inc.
 - k. Watts Radiant; A WATTS Brand
 - l. Zurn Industries, LLC
2. Source Limitations: Obtain PEX tube from single manufacturer.
3. Tube Material: PEX plastic in accordance with ASTM F876 and ASTM F877.

B. PEX Tube Fittings - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. NIBCO INC.
 - b. SharkBite, A Division of Reliance Worldwide Corporation
 - c. Uponor
 - d. Zurn Industries, LLC
2. Source Limitations: Obtain PEX tube fittings from single manufacturer.
3. Fittings: ASTM F1807, metal insert and copper crimp rings or ASTM F1960, cold expansion fittings and reinforcing rings.
4. Push-Fit Fittings: ASSE 1061, push-fit fittings.

C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

2.6 PVC PIPE AND FITTINGS - DOMESTIC WATER

- A. PVC Pipe - Domestic Water: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Charlotte Pipe and Foundry Company
 - b. Spears Manufacturing Company
 - 2. Source Limitations: Obtain PVC pipe from single manufacturer.
- B. PVC Socket Fittings: ASTM D2466 for Schedule 40 and ASTM D2467 for Schedule 80.
- C. PVC Schedule 80 Threaded Fittings: ASTM D2464.

2.7 PIPING JOINING MATERIALS - DOMESTIC WATER

- 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 B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.
 - 1. Solvent cement shall have a VOC content of 510 g/L or less.
 - 2. Adhesive primer shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.8 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.

2.9 TRANSITION FITTINGS - DOMESTIC WATER

- A. General Requirements:

1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Pipeline Solutions
 - c. Ford Meter Box Company, Inc. (The)
 - d. Jay R. Smith Mfg Co; a division of Morris Group International
 - e. JCM Industries, Inc
 - f. Romac Industries, Inc.
 - g. Smith-Blair, a Xylem brand.
 - h. Viking Johnson
 2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.
- D. Plastic-to-Metal Transition Fittings - Domestic Water:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. aquatherm
 - b. Charlotte Pipe and Foundry Company
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Spears Manufacturing Company
 - e. Uponor
 2. Source Limitations: Obtain plastic-to-metal transition fittings from single source.
 3. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions - Domestic Water:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. aquatherm
 - b. Colonial Engineering, Inc.
 - c. NIBCO INC.
 - d. Spears Manufacturing Company
 2. Source Limitations: Obtain plastic-to-metal transition unions from single manufacturer.
 3. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass or stainless steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.10 DIELECTRIC FITTINGS - DOMESTIC WATER

- 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 - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. HART Industrial Unions, LLC
 - d. Jomar Valve
 - e. Matco-Norca
 - f. WATTS; A Watts Water Technologies Company
 - g. Zurn Industries, LLC
 - 2. Source Limitations: Obtain dielectric unions from single manufacturer.
 - 3. Standard: ASSE 1079.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.
 - 5. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Capitol Manufacturing Company
 - b. GF Piping Systems: Georg Fischer LLC
 - c. Matco-Norca
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
 - 2. Source Limitations: Obtain dielectric flanges from single manufacturer.
 - 3. Standard: ASSE 1079.
 - 4. Factory-fabricated, bolted, companion-flange assembly.
 - 5. Pressure Rating: 125 psig minimum at 180 deg F.
 - 6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Products & Systems, LLC
 - b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries
 - 2. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
 - 3. Nonconducting materials for field assembly of companion flanges.
 - 4. Pressure Rating: 150 psig .
 - 5. Gasket: Phenolic, Temperature Rating: 225 deg F.
 - 6. Bolt Sleeves: Phenolic or polyethylene.
 - 7. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Matco-Norca
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Victaulic Company
2. Source Limitations: Obtain dielectric nipples from single manufacturer.
3. Standard: IAPMO PS 66.
4. Electroplated steel nipple complying with ASTM F1545.
5. Pressure Rating and Temperature: 300 psig at 225 deg F.
6. End Connections: Male threaded or grooved.
7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller is to be the following:
 1. Annealed-temper copper tube, ASTM B88, Type K or ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed or copper pressure-seal fittings; and pressure-sealed joints.
 2. PVC, Schedule 80; socket fittings; and solvent-cemented joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger is to be the following:
 1. Annealed-temper copper tube, ASTM B88, Type K or ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 3. PVC, Schedule 80; socket fittings; and solvent-cemented joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) is to be the following:
 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 1. Drawn-temper or annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed or copper pressure-seal-joint fittings; and pressure-sealed joints.
 2. PVC, Schedule 80; socket fittings; and solvent-cemented joints.
- H. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 1. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.

2. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; copper push-on joint fittings; and push-on joints.
4. PEX tube, NPS 1 and smaller.

a. Fittings for PEX tube:

- 1) ASTM F1807, metal insert and copper crimp rings.
- 2) ASTM F1960, cold expansion fittings and reinforcing rings.
- 3) ASSE 1061, push-fit fittings.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) is to be the following:

1. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.

J. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), is to be the following:

1. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L or ASTM B88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.

K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) is to be the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

3.2 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 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 in accordance with CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.
- D. Install domestic water piping level and plumb.
- E. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. 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.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install PEX tube with loop at each change of direction of more than 90 degrees.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.4 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 in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

- K. Joint Construction for Grooved-End Steel Piping: Make joints in accordance with AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. PVC Piping: Join in accordance with ASTM D2855.
- N. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
- O. Joints for PEX Tubing, ASSE: Join in accordance with ASSE 1061 for push-fit fittings.
- P. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 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 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings, nipples, and unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges, flange kits, or nipples.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers for metallic pipes 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.
- B. Install vinyl-coated hangers for nonmetallic pipe, 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.

- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of metallic pipe] to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support vertical runs of nonmetallic pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING 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.

3.9 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 in accordance with 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.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
- f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

- g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 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 for domestic water piping.
7. Outlet boxes.
8. Hose bibbs.
9. Wall hydrants.
10. Post hydrants.
11. Roof hydrants.
12. Water-hammer arresters.
13. Trap-seal primer device.
14. Trap-seal primer systems.

1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Cash Acme Plumbing Products; an RWC brand
 - c. FEBCO; A WATTS Brand
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.

- B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Cash Acme Plumbing Products; an RWC brand
 - c. Champion-Arrowhead
 - d. MIFAB, Inc
 - e. WATTS; A Watts Water Technologies Company
 - f. Woodford Manufacturing Company
 - g. 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.

- C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. FEBCO; A WATTS Brand
 - c. WATTS; A Watts Water Technologies Company
 - 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.

- D. Laboratory-Faucet Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. WATTS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC
2. Standard: ASSE 1035.
3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. WATTS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Caleffi North America
 - c. Cash Acme Plumbing Products; an RWC brand
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: [NPS 1/2] [NPS 3/4].
5. Body: Bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Caleffi North America
 - d. FEBCO; A WATTS Brand
 - e. WATTS; A Watts Water Technologies Company
 - f. Zurn Industries, LLC
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze, cast silicon copper alloy, or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for

- NPS 2-1/2 and larger.
 - 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 7. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- C. Double-Check, Backflow-Prevention Assemblies:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. FEBCO; A WATTS Brand
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
 - 2. Standard: ASSE 1015.
 - 3. Operation: Continuous-pressure applications unless otherwise indicated.
 - 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
 - 5. Body: Bronze, cast silicon copper alloy, or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
 - 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 7. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
- D. Beverage-Dispensing-Equipment Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. WATTS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC
 - 2. Standard: ASSE 1022.
 - 3. Operation: Continuous-pressure applications.
 - 4. End Connections: Threaded or flare.
- E. Dual-Check-Valve Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Cash Acme Plumbing Products; an RWC brand
 - d. Flomatic Valves; Flomatic Corporation
 - e. WATTS; A Watts Water Technologies Company
 - f. Zurn Industries, LLC
 - 2. Standard: ASSE 1024.
 - 3. Operation: Continuous-pressure applications.

4. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. WATTS; A Watts Water Technologies Company
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Body: Stainless steel.
5. End Connections: Threaded or flare.

G. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. WATTS; A Watts Water Technologies Company
 - c. Woodford Manufacturing Company
 - d. Zurn Industries, LLC
2. Standard: ASSE 1052.
3. Operation: Up to 10-ft. head of water back pressure.
4. Inlet Size: NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

H. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. FEBCO; A WATTS Brand
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Caleffi North America
 - c. Cash Acme Plumbing Products; an RWC brand
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; bronze or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.

5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

B. Water-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. CLA-VAL
 - c. Flomatic Valves; Flomatic Corporation
 - d. IMI Hydronic Engineering Inc
 - e. OCV Control Valves
 - f. WATTS; A Watts Water Technologies Company
 - g. Zurn Industries, LLC
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless steel body.
 - a. Trim: Stainless steel.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bell & Gossett; a Xylem brand
 - b. IMI Hydronic Engineering Inc
 - c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control
 - d. NIBCO INC.
 - e. WATTS; A Watts Water Technologies Company
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Caleffi North America
 - c. Crane Fluid Systems; Crane Co.
 - d. Hammond Valve
 - e. Jenkins Valves; a Crane Co. brand
 - f. Milwaukee Valve Company
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - i. Stockham; a Crane Co. brand
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.

4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

C. Automatic Flow Control Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. aleffi North America
 - b. [IMI Hydronic Engineering Inc
 - c. ThermOmegaTech
2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscaling polymer.
7. End Connections: Threaded or solder joint.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Acorn Engineering Company; a Division of Morris Group International
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Cash Acme Plumbing Products; an RWC brand
 - d. POWERS; A Watts Water Technologies Company
 - e. Symmons Industries, Inc
 - f. Taco Comfort Solutions
 - g. WATTS; A Watts Water Technologies Company
 - h. Zurn Industries, LLC
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Acorn Engineering Company; a Division of Morris Group International
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Caleffi North America
 - d. Cash Acme Plumbing Products; an RWC brand
 - e. Lawler Manufacturing Company, Inc
 - f. POWERS; A Watts Water Technologies Company

- g. Symmons Industries, Inc
 - h. [WATTS; A Watts Water Technologies Company
 - i. Zurn Industries, LLC
- 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 4. Type: Thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded inlets and outlet.
 - 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

Retain "Tempered-Water Design Flow Rate" Subparagraph below only if flow rate is not indicated on Drawings.

C. Primary, Electronic, Water Mixing Valve Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Acorn Engineering Company; a Division of Morris Group International
 - b. Caleffi North America
 - c. Leonard Valve Company
 - d. POWERS; A Watts Water Technologies Company
- 2. Standard: ASSE 1017.
- 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 4. Type: Exposed, electronically controlled, water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: Threaded or solder joint inlets and outlet.
- 7. Accessories: Manual temperature override control, check stops on hot- and cold-water supplies, and automatic hot- and cold-water shutoff upon inlet supply failure.
- 8. Valve Finish: Bronze.
- 9. Digital temperature control and monitoring module.
 - a. Controls temperature within plus or minus 2 deg F.
 - b. User programmable at module or through BAS.
 - c. ASHRAE 188 compliance.
 - d. Local and remote monitoring.
 - e. Battery backup.

D. Manifold, Thermostatic, Water Mixing Valve Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Acorn Engineering Company; a Division of Morris Group International
 - b. POWERS; A Watts Water Technologies Company
 - c. Symmons Industries, Inc
 - d. WATTS; A Watts Water Technologies Company
- 2. Description: Factory-fabricated, thermostatically controlled, water mixing valve assembly in parallel arrangement.
- 3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gauges on inlet and outlet.
- 4. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gauges on inlet and outlet.
- 5. Small-Flow Parallel: Thermostatic, water mixing valve.
- 6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
- 7. Water Regulator(s): Comply with ASSE 1003. Include pressure gauge on inlet and outlet.
- 8. Pressure Rating: 125 psig minimum unless otherwise indicated.

E. Photographic-Process, Thermostatic, Water Mixing Valve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. POWERS; A Watts Water Technologies Company
 - b. WATTS; A Watts Water Technologies Company
2. Standard: ASSE 1017, thermostatically controlled, water mixing valve made for precise, process-water temperature control.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, thermometer, shutoff valve, and adjustable, temperature-control handle.
7. Cabinet: Factory fabricated, stainless steel, for surface mounting; with controls and thermometer mounted on front.

F. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. corn Engineering Company; a Division of Morris Group International
 - b. [Caleffi North America
 - c. Lawler Manufacturing Company, Inc
 - d. POWERS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.

G. Primary Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Heat-Timer Corporation
 - b. Holby Valve Inc.
 - c. WATTS; A Watts Water Technologies Company
2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body.
5. Temperature Control: Manual.
6. Connections: Threaded inlets and outlet.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Keckley Company
 - b. Titan Flow Control, Inc.

- c. WATTS; A Watts Water Technologies Company
 - d. Zurn Industries, LLC
- 2. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
 - 4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 5. Screen: Stainless steel with round perforations unless otherwise indicated.

2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Acorn Engineering Company; a Division of Morris Group International
 - b. Guy Gray, IPS Corporation
 - c. LSP Products Group
 - d. Oatey Co.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Symmons Industries, Inc
 - g. Water-Tite, IPS Corporation
- 2. Mounting: Recessed.
- 3. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
- 4. Drain Outlet Connection: NPS 1-1/2.
- 5. Accessory: Water hammer arresters.
- 6. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
- 7. Drain: NPS 1-1/2 standpipe and P-trap for direct waste connection to drainage piping.

B. Icemaker Outlet Boxes:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Guy Gray, IPS Corporation
 - b. LSP Products Group
 - c. Oatey Co.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Water-Tite, IPS Corporation
- 2. Mounting: Recessed.
- 3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
- 4. Accessory: Water hammer arrestor.
- 5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.10 HOSE BIBBS

A. Hose Bibbs:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. MIFAB, Inc
 - c. Prier Products, Inc.

- d. WATTS; A Watts Water Technologies Company
 - e. Woodford Manufacturing Company
 - f. Zurn Industries, LLC
-
- 2. Standard: ASME A112.18.1 for sediment faucets.
 - 3. Body Material: Bronze.
 - 4. Seat: Bronze, replaceable.
 - 5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 - 6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 7. Pressure Rating: 125 psig.
 - 8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - 9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 - 10. Finish for Service Areas: Rough bronze.
 - 11. Finish for Finished Rooms: Chrome or nickel plated.
 - 12. Operation for Equipment Rooms: Wheel handle or operating key.
 - 13. Operation for Service Areas: Wheel handle.
 - 14. Operation for Finished Rooms: Wheel handle.
 - 15. Include operating key with each operating-key hose bibb.
 - 16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.11 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. MIFAB, Inc
 - c. Murdock Manufacturing; A Division of Morris Group International
 - d. Prier Products, Inc.
 - e. WATTS; A Watts Water Technologies Company
 - f. Woodford Manufacturing Company
 - g. Zurn Industries, LLC
- 2. Standard: ASME A112.21.3M 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 or NPS 1.
- 7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 8. Box: Deep, flush mounted with cover.
- 9. Box and Cover Finish: Rough bronze.
- 10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 11. Nozzle and Wall-Plate Finish: Polished nickel bronze or Chrome plated.
- 12. Operating Keys(s): One with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. MIFAB, Inc
 - c. Murdock Manufacturing; A Division of Morris Group International

- d. Prier Products, Inc.
 - e. WATTS; A Watts Water Technologies Company
 - f. Woodford Manufacturing Company
 - g. Zurn Industries, LLC
 - 2. Standard: ASME A112.21.3M 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 or NPS 1.
 - 7. Outlet: Concealed.
 - 8. Box: Deep, flush mounted with cover.
 - 9. Box and Cover Finish: Polished nickel bronze or Chrome plated.
 - 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 Key(s): One with each wall hydrant.
- C. Nonfreeze Vacuum Breaker Wall Hydrants:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Champion-Arrowhead
 - c. Jay R. Smith Mfg Co; a division of Morris Group International
 - d. Prier Products, Inc.
 - e. WATTS; A Watts Water Technologies Company
 - f. Woodford Manufacturing Company
 - g. Zurn Industries, LLC
 - 2. Standard: ASSE 1019, Type A or Type B.
 - 3. Type: Automatic draining with integral air-inlet valve.
 - 4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
 - 5. Pressure Rating: 125 psig.
 - 6. Operation: Loose key.
 - 7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 - 8. Inlet: NPS 1/2 or NPS 3/4.
 - 9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.12 POST HYDRANTS

- A. Nonfreeze, Draining-Type Post Hydrants:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. MIFAB, Inc
 - c. Murdock Manufacturing; A Division of Morris Group International
 - d. Prier Products, Inc.
 - e. WATTS; A Watts Water Technologies Company
 - f. Woodford Manufacturing Company
 - g. Zurn Industries, LLC
 - 2. Standard: ASME A112.21.3M.

3. Type: Nonfreeze, exposed-outlet post hydrant.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Casing: Bronze with casing guard.
7. Inlet: NPS 3/4.
8. Outlet: Garden-hose thread complying with ASME B1.20.7.
9. Drain: Designed with hole to drain into ground when shut off.
10. Vacuum Breaker:
 - a. Nonremovable, drainable, 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 Key(s): One with each loose-key-operation wall hydrant.

B. Nonfreeze Sanitary Yard Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hoepfner Products
 - b. Jay R. Smith Mfg Co; a division of Morris Group International
 - c. Murdock Manufacturing; A Division of Morris Group International
 - d. Woodford Manufacturing Company
2. Standard: ASSE 1057.
3. Operation: Wheel handle or lever.
4. Head: Cast iron or brass, with pail hook.
5. Inlet: NPS 3/4 or NPS 1 threaded.
6. Length: As required for burial of valve and canister below frost line.
7. Canister: Stainless steel.
8. Vacuum Breaker:
 - a. Removable hose-connection backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet for field installation.

2.13 ROOF HYDRANTS

A. Nonfreeze, Draining-Type Roof Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. MIFAB, Inc
 - c. Murdock Manufacturing; A Division of Morris Group International
 - d. Prier Products, Inc.
 - e. WATTS; A Watts Water Technologies Company
 - f. Woodford Manufacturing Company
 - g. Zurn Industries, LLC
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, exposed-outlet roof hydrant with coated cast-iron head and lift handle with lock option. Provide with deck flange and under deck clamp.
4. Casing and Operating Rod: Bronze interior parts, galvanized-steel casing, and bronze valve housing designed with hole to drain.
5. Inlet: NPS 3/4.
6. Outlet: Garden-hose thread complying with ASME B1.20.7.
7. Vacuum Breaker:

- a. Nonremovable, drainable, 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.

2.14 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. AMTROL, Inc.
 - b. Jay R. Smith Mfg Co; a division of Morris Group International
 - c. MIFAB, Inc
 - d. Precision Plumbing Products
 - e. ProFlo; a Ferguson Enterprises, Inc. brand
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. WATTS; A Watts Water Technologies Company
 - h. Zurn Industries, LLC
2. Standard: ASSE 1010 or PDI-WH 201.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.15 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. MIFAB, Inc
 - d. Precision Plumbing Products
 - e. ProFlo; a Ferguson Enterprises, Inc. brand
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. WATTS; A Watts Water Technologies Company
 - h. Zurn Industries, LLC
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. MIFAB, Inc
 - c. Precision Plumbing Products
 - d. Zurn Industries, LLC
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.16 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Precision Plumbing Products
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Zurn Industries, LLC
2. Standard: ASSE 1044.
3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
4. Cabinet: Steel box with stainless steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 V ac power.
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Vacuum Breaker: ASSE 1001.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install 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. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- C. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- D. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- E. Temperature-Actuated, Water Mixing Valves: Install 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. Y-Pattern Strainers: For water, install on supply side of each connected device.
- G. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- H. Nonfreeze, Draining-Type Post Hydrants: Install with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- I. Nonfreeze, Nondraining-Type Post Hydrants: Set in concrete or pavement.

- J. Nonfreeze, Sanitary Yard Hydrants: Set with riser pipe in concrete or pavement. Do not encase canister in concrete.
- K. Nonfreeze, Draining-Type Roof Hydrants: Install with drain connection piped to nearest floor drain or to the exterior.
- L. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- M. Supply-Type, Trap-Seal Primer Device: Install 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.
- N. Drainage-Type, Trap-Seal Primer Device: Install 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.
- O. Trap-Seal Primer Systems: Install 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.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 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.

3.5 FIELD QUALITY CONTROL

- A. Perform the following 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 unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 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. Ductile-iron pipe and fittings.
5. Copper tube and fittings.
6. PVC pipe and fittings.
7. Specialty pipe fittings.
8. Encasement for underground metal piping.

1.2 ACTION SUBMITTALS

A. Product Data:

1.3 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 in accordance with requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without [Owner's permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water.
2. Waste, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

A. Piping materials to bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AB & I Foundry; a part of the McWane family of companies
2. Charlotte Pipe and Foundry Company
3. Tyler Pipe; a part of McWane family of companies

B. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A74, service and extra-heavy cast iron.

C. Gaskets: ASTM C564, rubber.

D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AB & I Foundry; a part of the McWane family of companies
2. Charlotte Pipe and Foundry Company
3. Tyler Pipe; a part of McWane family of companies

B. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A888 or CISPI 301.

C. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Conine Manufacturing Co., Inc
- b. SE Sovent

D. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. ANACO-Husky
- b. Charlotte Pipe and Foundry Company
- c. Dallas Specialty & Mfg. Co
- d. [Fernco Inc
- e. Ideal Tridon Group
- f. Matco-Norca
- g. MIFAB, Inc
- h. Mission Rubber Company, LLC; a division of MCP Industries
- i. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C1277 and CISPI 310.

3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

E. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. AB & I Foundry; a part of the McWane family of companies
 - b. ANACO-Husky
 - c. Charlotte Pipe and Foundry Company
 - d. Clamp-All Corp
 - e. Dallas Specialty & Mfg. Co.
 - f. Ideal Tridon Group
 - g. MIFAB, Inc
 - h. Mission Rubber Company, LLC; a division of MCP Industries
 - i. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C1277 and ASTM C1540.
3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. U.S. Steel
 2. Wheatland Tube; Zekelman Industries
- B. Galvanized-Steel Pipe: ASTM A53/A53M, Type E, standard-weight cast iron. Include square-cut-grooved or threaded ends matching joining method.
- C. Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- D. Steel Pipe Pressure Fittings:
 1. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Cast-Iron Flanges: ASME B16.1, Class 125.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- F. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Shurjoint; a part of Aalberts Integrated Piping Systems
 - d. Smith-Cooper International
 - e. Star Pipe Products
 - f. Victaulic Company
 2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A536, ductile-iron castings; ASTM A47/A47M, malleable-iron castings; ASTM A234/A234M, forged steel fittings; or ASTM A106/A106M, steel pipes with dimensions matching ASTM A53/A53M, steel pipe, and complying with AWWA C606 for grooved ends.

3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F1476, Type I. Include ferrous housing sections with continuous curved keys, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

2.6 DUCTILE-IRON PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. American Cast Iron Pipe Company
 2. Apollo Valves; a part of Aalberts Integrated Piping Systems
 3. McWane Ductile
 4. U.S. Pipe, a Forterra company
- B. Ductile-Iron, Mechanical-Joint Piping:
 1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
 2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Ductile-Iron, Push-on-Joint Piping:
 1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
 2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 3. Gaskets: AWWA C111/A21.11, rubber.
- D. Ductile-Iron, Grooved-Joint Piping: AWWA C151/A21.51, with round-cut-grooved ends in accordance with AWWA C606.
- E. Ductile-Iron, Grooved-End Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Shurjoint; a part of Aalberts Integrated Piping Systems
 - c. Smith-Cooper International
 - d. Star Pipe Products
 - e. Victaulic Company
 2. Grooved-End, Ductile-Iron Fittings: ASTM A536, ductile-iron castings, with dimensions matching AWWA C110/A 21.10, ductile-iron pipe or AWWA C153/A 21.53, ductile-iron fittings, and complying with AWWA C606 for grooved ends.
 3. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F1476, Type I. Include ferrous housing sections with continuous curved keys, EPDM-rubber center-leg gasket suitable for hot and cold water, and bolts and nuts.

2.7 COPPER TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Apollo Valves; a part of Aalberts Integrated Piping Systems
 2. Cambridge-Lee Industries, LLC

3. Cerro Flow Products, LLC
 4. Wieland Copper Products, LLC
- B. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- D. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.
- E. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.
- F. Copper Pressure Fittings:
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- G. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- H. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.8 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Apollo Valves; a part of Aalberts Integrated Piping Systems
 2. Charlotte Pipe and Foundry Company
 3. GF Piping Systems
 4. JM Eagle
 5. National Pipe and Plastic, Inc.
 6. North America Pipe Corporation
 7. Rocky Mountain Colby Pipe Company
 8. Silver-line Plastics
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- E. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- F. Adhesive Primer: ASTM F656.
1. Adhesive primer shall have a VOC content of 550 g/L or less.
 2. Adhesive primer shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or

33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

G. Solvent Cement: ASTM D2564.

1. Solvent cement shall have a VOC content of 510 g/L or less.

2.9 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 of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc
 - 3) Mission Rubber Company, LLC; a division of MCP Industries
 - 4) Plastic Oddities
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 - e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries
 - b. Standard: ASTM C1460.
 - 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.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems
 - 2) Cascade Waterworks Mfg. Co.
 - 3) EBAA Iron Sales, Inc.
 - 4) Ford Meter Box Company, Inc. (The)
 - 5) JCM Industries, Inc
 - 6) Romac Industries, Inc.

- b. Standard: AWWA C219.
- c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) A.Y. McDonald Mfg. Co.
 - 2) Capitol Manufacturing Company
 - 3) GF Piping Systems: Georg Fischer LLC
 - 4) HART Industrial Unions, LLC
 - 5) Jomar Valve
 - 6) Matco-Norca
 - 7) WATTS; A Watts Water Technologies Company
 - 8) Wilkins
 - 9) Zurn Industries, LLC
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Capitol Manufacturing Company
 - 2) GF Piping Systems: Georg Fischer LLC
 - 3) Matco-Norca
 - 4) WATTS; A Watts Water Technologies Company
 - 5) Zurn Industries, LLC
 - 6)
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F .
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- 4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Advance Products & Systems, LLC
 - 2) CALPICO, Inc.
 - 3) GF Piping Systems: Georg Fischer LLC
 - 4) GPT; a division of EnPRO Industries

b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: 150 psig.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1) Anvil; an ASC Engineered Solution
- 2) Elster Perfection; Honeywell
- 3) Matco-Norca
- 4) Precision Plumbing Products
- 5) Victaulic Company

b. Description:

- 1) Standard: IAPMO PS 66.
- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig at 225 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.10 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: [linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- 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 to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. 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: Two 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. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with 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 accordance with ASTM A674 or AWWA C105/A 21.5.
- N. Install steel piping in accordance with applicable plumbing code.
- O. Install stainless steel piping in accordance with ASME A112.3.1 and applicable plumbing code.
- P. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- Q. Install aboveground PVC piping in accordance with ASTM D2665.
- R. Install underground PVC piping in accordance with ASTM D2321.
- S. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- T. Install underground, ductile-iron, force-main piping according to AWWA C600.
1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
 2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 3. Install encasement on piping installed in corrosive soil in accordance with ASTM A674 or AWWA C105/A 21.5.
- U. Install underground, copper, force-main tubing in accordance with CDA's "Copper Tube Handbook."
1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- V. Install force mains at elevations indicated.
- W. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
 2. 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.
 3. Install drains in sanitary waste gravity-flow piping.
- X. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Y. Install sleeves for piping penetrations of walls, ceilings, and floors.
- Z. Install sleeve seals for piping penetrations of concrete walls and slabs.
- AA. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints:
1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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.
- E. Join stainless steel pipe and fittings with gaskets in accordance with ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 - 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- J. 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 5 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 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.3 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste 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 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples or unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges, flange kits, or nipples.
 - 4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.4 INSTALLATION OF VALVES

- A. General valve installation requirements for general-duty valve installation are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for metallic soil 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.
- C. Install hangers for nonmetallic 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.
- D. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- E. Support vertical runs of metallic soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of nonmetallic 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.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor.
 - 6. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main.
 - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

- a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.8 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. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:
 - 1. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
 - 3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 - 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 4. Stainless steel pipe and fittings, sealing rings, and gasketed joints.
 - 5. PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 6. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 (DN 100) is to be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. [PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 (DN 125) and larger is to be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; [CISPI] [heavy-duty] hubless-piping couplings; and coupled joints.
 - 2. PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
 - 1. Extra-heavy or Service cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty or cast-iron hubless-piping couplings; and coupled joints.
 - 3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 - 1. Extra-heavy, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty or cast-iron hubless-piping couplings; coupled joints.
 - 3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Nonpressure transition couplings.
- H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) are to be the

following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 (DN 65 to DN 150) are to be the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- J. Underground sanitary-sewage force mains NPS 4 (DN 100) and smaller are to be the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.
- K. Underground sanitary-sewage force mains NPS 5 (DN 125) and larger are to be the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Backwater valves.
 2. Cleanouts.
 3. Air-admittance valves.
 4. Miscellaneous sanitary drainage piping specialties.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves (Insert drawing designation, if any):
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. MIFAB, Inc
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
 2. Standard: ASME A112.14.1.
 3. Size: Same as connected piping.
 4. Body: Cast iron.
 5. Cover: Cast iron with access check valve.

6. Type Check Valve: Removable, bronze, swing check, factory assembled.
7. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves (Insert drawing designation, if any):

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. WATTS; A Watts Water Technologies Company
 - d. Zurn Industries, LLC
2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze; made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves (Insert drawing designation, if any):

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Endura; a brand of IPEX
 - b. IPS Corporation
 - c. NDS Inc
 - d. Oatey Co.
 - e. Plastic Oddities
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Industries, LLC
2. Size: Same as connected piping.
3. Cover: Same material as body with threaded access to check valve.
4. Check Valve: Removable swing check.
5. End Connections: Socket type.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts (Insert drawing designation, if any):

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. MIFAB, Inc
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS; A Watts Water Technologies Company
 - f. Zurn Industries, LLC
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Closure: Countersunk plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Stainless Steel Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. BLÜCHER; A Watts Water Technologies Company
 - b. Josam Company
 2. Standard: ASME A112.3.1.
 3. Size: Same as connected drainage piping.
 4. Body Material: Stainless steel tee with side cleanout as required to match connected piping.
 5. Closure: Stainless steel plug with seal.
- C. Cast-Iron Exposed Floor Cleanouts (Insert drawing designation, if any):
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. MIFAB, Inc
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. WATTS; A Watts Water Technologies Company
 - f. Zurn Industries, LLC
 2. Standard: ASME A112.36.2M.
 3. Size: Same as connected branch.
 4. Body or Ferrule: Cast iron.
 5. Closure: [Brass plug with tapered threads.
 6. Adjustable Housing Material: Cast iron.
 7. Frame and Cover Material and Finish: Nickel-bronze, copper alloy .
 8. Riser: ASTM A74, Extra-Heavy Class, cast-iron drainage pipe fitting and riser to cleanout.
- D. Stainless Steel Exposed Floor Cleanouts:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. BLÜCHER; A Watts Water Technologies Company
 - b. Josam Company
 - c. Kusel Equipment Co]
 - d. Zurn Industries, LLC
 2. Standards: ASME A112.3.1.
 3. Size: Same as connected branch.
 4. Housing: Stainless steel.
 5. Closure: Stainless steel with seal].
 6. Riser: ASTM A74, Extra-Heavy Class, stainless steel or cast-iron drainage pipe fitting and riser to cleanout.
 7. Body or Ferrule: Stainless steel.
 8. Adjustable Housing Material: Cast iron with threads.
 9. Frame and Cover Material and Finish: Stainless steel.
 10. Top-Loading Classification: Extra Heavy Duty.
- E. Cast-Iron Wall Cleanouts (Insert drawing designation, if any):
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. MIFAB, Inc
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Closure Plug:

- a. Brass or cast iron.
 - 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.
 4. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
- F. Plastic Floor Cleanouts (Insert drawing designation, if any):
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Endura; a brand of IPEX
 - b. IPS Corporation
 - c. NDS Inc
 - d. Plastic Oddities
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Industries, LLC
 2. Size: Same as connected branch.
 3. Body: PVC.
 4. Closure Plug: PVC.
 5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.4 AIR-ADMITTANCE VALVES

- A. Fixture Air-Admittance Valves (Insert drawing designation, if any):
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ayrlett, LLC
 - b. Oatey Co.
 - c. ProVent Systems
 - d. Studor, Inc
 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 3. Housing: Plastic.
 4. Operation: Mechanical sealing diaphragm.
 5. Size: Same as connected fixture or branch vent piping.
- B. Stack Air-Admittance Valves (Insert drawing designation, if any):
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Oatey Co.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Studor, Inc
 2. Standard: ASSE 1050 for vent stacks.
 3. Housing: Plastic.
 4. Operation: Mechanical sealing diaphragm.
 5. Size: Same as connected stack vent or vent stack.
- C. Wall Box for Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Oatey Co.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Studor, Inc
2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: Approximately 6 inches wide by 6 inches high by 4 inches deep.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Floor-Drain, Inline Trap Seal (Insert drawing designation, if any):

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Green Drain, Inc.
 - b. Jay R. Smith Mfg Co; a division of Morris Group International
 - c. Josam Company
 - d. MIFAB, Inc
 - e. RectorSeal Plumbing; A CSW Industrials Company
2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

E. 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.

F. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

G. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

I. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

J. 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 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install fixture air-admittance valves on fixture drain piping.
- F. Install stack air-admittance valves at top of stack vent and vent stack piping.
- G. Install air-admittance-valve wall boxes recessed in wall.
- H. Assemble open drain fittings and install with top of hub 1 inch above floor.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- M. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- O. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- P. Install wood-blocking reinforcement for wall-mounting-type specialties.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Install piping adjacent to equipment, to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 33 00

ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Commercial, light-duty, storage, electric, domestic-water heaters.
 2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

- A. Product Data Submittals: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 2. Warranty Periods: From date of Substantial Completion.
 - a. Electric, Domestic-Water Heaters:
 - 1) Storage Tank (if applicable): Three years.
 - 2) Controls and Other Components: Three years.
 - b. Expansion Tanks: Five years.

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 use.
- B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- D. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A. O. Smith Corporation
 - b. American Water Heaters
 - c. Bradford White Corporation
 - d. Electric Heater Company (The)
 - e. Heat Transfer Products, Inc
 - f. Lochinvar, LLC
 - g. Rheem Manufacturing Company
 - h. Ruud Water Heaters; a Rheem brand
 - i. State Industries
 - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 - 3. Standard: UL 174.
 - 4. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 5. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1.
 - e. Jacket: Steel with enameled finish or high-impact composite material.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Electric, screw-in immersion type.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.
 - 6. Special Requirements: NSF 5 construction with legs for off-floor installation.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A. O. Smith Corporation
 - b. AMTROL, Inc.
 - c. Flexcon Industries
 - d. Honeywell International Inc.
 - e. Pentair Aurora; Pentair Pump Group
 - f. ProFlo; a Ferguson Enterprises, Inc. brand
 - g. State Industries
 - h. Taco Comfort Solutions

2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE/IES 90.1.
- E. Manifold Kits: Domestic-water-heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
 1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water.
- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base or wall bracket as indicated on drawings.
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install thermometers on outlet piping of electric, domestic-water heaters.
- G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters
- H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet.
- I. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig.
- J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

- K. Fill electric, domestic-water heaters with water.
- L. Charge domestic-water expansion tanks with air to required system pressure.
- M. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- 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 operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Sleeves without waterstop.
3. Sleeves with waterstop.
4. Stack-sleeve fittings.
5. Sleeve-seal systems.
6. Grout.
7. Silicone sealants.

1.2 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.

1.3 QUALITY ASSURANCE

- ###### **A. Welding Qualifications:** Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- ###### **B. Pipe and Pressure-Vessel Welding Qualifications:** Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.4 COORDINATION

- ###### **A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:**
1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in

- equipment schedules or Sections.
- 3. Comply with NEMA MG 1 unless otherwise indicated.
- 4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

- 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
- 2. 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. Polyphase Motors:

- 1. Description: NEMA MG 1, Design B, medium induction motor.
- 2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
- 3. Service Factor: 1.15.
- 4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
- 5. Multispeed Motors, Two Winding: Separate winding for each speed.
- 6. Rotor: Random-wound, squirrel cage.
- 7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- 8. Temperature Rise: Match insulation rating.
- 9. Insulation: Class F.
- 10. Code Letter Designation:
 - a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.
- 11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

- 1. 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.
- 2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. 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.
 - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- 3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

- 1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.

- c. Capacitor start, inductor run.
- d. Capacitor start, capacitor run.
- 2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- 3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- 4. Motors 1/20 hp and Smaller: Shaded-pole type.
- 5. 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 will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

- 1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
- 2. Three-phase power motor module with permanent magnet rotor.
- 3. Circuit board or digital speed controller/LED display.
- 4. Building Automation System Interface: Via AC voltage signal, DC voltage signal, or Digital Serial Interface (DSI).

2.2 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

- 1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
- 2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- 3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
- 4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
- 5. Molded-PVC Sleeves: With nailing flange.
- 6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Products & Systems, LLC
 - b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries
 - d. Metraflex Company (The)
- 2. Description: Manufactured PVC/HDPE, steel, stainless steel, or galvanized-steel, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Wade; a subsidiary of McWane Inc.
 - c. Zurn Industries, LLC
- 2. Description: Manufactured, Dura-coated, Duco-coated, or galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

- a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Products & Systems, LLC
 - b. Airex Manufacturing Inc.
 - c. CALPICO, Inc.
 - d. GPT; a division of EnPRO Industries
 - e. Metraflex Company (The)
 - f. Proco Products, Inc
- 2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - a. Hydrostatic seal: 20 psig.
 - b. Sealing Elements: EPDM-rubber, High-temperature-silicone, or Nitrile (Buna-N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 - c. Pressure Plates: Carbon steel or Composite plastic for normal applications; Stainless steel if installed in acidic soils.
 - d. Connecting Bolts and Nuts: Carbon steel, with zinc coating. ASTM B633 for standard applications; Stainless steel if installed in acidic soils, of length required to secure pressure plates to sealing elements.

E. Grout:

- 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- 2. Standard: ASTM C1107/C1107M, 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.

F. Silicone Sealants:

- 1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) ITW Polymers Sealants North America
 - 3) Polymeric Systems, Inc
 - 4) Sherwin-Williams Company (The)
 - 5) Sika Corporation
 - 6) The Dow Chemical Company
 - 7) Tremco Incorporated
 - b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
- 2. Silicone Sealant, S, P, T, NT: Single-component, 25 or 100/50, pourable, plus 25 percent and minus 25 percent; or plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Pecora Corporation
 - 2) Sika Corporation

- 3) The Dow Chemical Company
 - 4) Tremco Incorporated
- b. Standard: ASTM C920, Type S, Grade P, Class 25 or Class 100/50, Uses T and NT.
- 3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Smooth-On
- 4. Sealant shall have a VOC content of 250 g/L or less.
 - a. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. 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 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop 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 centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves.

3.3 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

3.5 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops or stack-sleeve fittings.
4. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports - metal.
2. Pipe hangers - metal, trapeze type.
3. Pipe hangers - FRP.
4. Strut support systems - metal, rod type.
5. Strut support systems - FRP.
6. Strut support systems - rooftop mounted.
7. Thermal-hanger shield inserts.
8. Fastener systems.
9. Equipment supports.
10. Equipment stands - outdoor type.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

1.3 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 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 are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with 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.

2.2 PIPE HANGERS AND SUPPORTS - METAL

A. Pipe Hangers and Supports - Carbon Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. B-Line; a division of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
3. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
4. Nonmetallic Coatings: Plastic coated, or epoxy powder coated.
5. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
6. Hanger Rods: Continuous-thread rod, nuts, and washers made of carbon steel.

B. Pipe Hangers and Supports - Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. B-Line; a division of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Pipe/Tube Hangers and Supports - Copper:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil; an ASC Engineered Solution
 - b. B-Line; a division of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
2. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel .

2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

- 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 PIPE HANGERS - FRP

A. Pipe Hangers - FRP, Clevis Type:

1. Description: Similar to MSS SP-58, Type 1, factory-fabricated steel pipe hanger except hanger is made of fiberglass-reinforced plastic resin.
2. Hanger Rods: Continuous-thread stainless steel rod, washer, and nuts made of FRP, polyurethane, or stainless steel.
3. Flammability: ASTM D635, ASTM E84, and UL 94.

B. Pipe Hangers - FRP, Strap Type:

1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger except hanger is made of fiberglass-reinforced plastic resin.
 - a. Flammability: ASTM D635, ASTM E84, and UL 94.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.5 STRUT SUPPORT SYSTEMS - METAL, ROD TYPE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ABB, Electrification Business
2. Anvil; an ASC Engineered Solution
3. Atkore Unistrut
4. B-Line; a division of Eaton, Electrical Sector
5. CADDY; brand of nVent Electrical plc
6. Carpenter & Paterson, Inc
7. Empire Industries, Inc.
8. Flex-Strut Inc.
9. G-Strut
10. Haydon Corporation
11. PHD Manufacturing, Inc
12. Rocket Rack; Robroy Industries
13. Wesanco/ZSi-Foster; an Ideal Tridon Group Company

- B. Description: Factory-fabricated pipe-support assembly made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.
- C. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
- D. Struts: Continuous slotted carbon-steel, stainless steel, or extruded-aluminum channel with intumed lips or angle.
- E. Strut Width: Selected for applicable load criteria.
- F. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- G. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel or stainless steel.
- H. Metallic Coating: Electroplated zinc or Hot-dip galvanized.
- I. Paint Coating: Green epoxy, acrylic, or urethane.
- J. Plastic Coating: PVC.

2.6 STRUT SUPPORT SYSTEMS - FRP

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Atkore Unistrut
2. Champion Fiberglass, Inc
3. G-Strut
4. Seasafe, Inc.; AMICO, a Gibraltar Industries Company

- B. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 2. Struts: Continuous slotted fiberglass-reinforced plastic channel with inturned lips.
 3. Strut Width: Selected for applicable load criteria.
 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
 6. Rated Strength: Selected to suit applicable load criteria.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.7 STRUT SUPPORT SYSTEMS - ROOFTOP MOUNTED

- A. General Requirements: Shop-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Pipe Stand - Compact:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. G-Strut
 - b. MIRO Industries Inc.
 - c. PHP Systems/Design
 - d. RectorSeal HVAC; a CSW Industrials Company
 2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 4. Hardware: Galvanized steel or polycarbonate.
 5. Accessories: Protection pads.
- C. Pipe Stand - Single Base, Single Pipe, Low Profile:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. G-Strut
 - b. MIRO Industries Inc.
 - c. PHP Systems/Design
 2. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 4. Vertical Members: Two, galvanized-steel or stainless steel, continuous-thread 1/2-inch rods.
 5. Horizontal Member: Adjustable-height, galvanized-steel or stainless steel pipe support channels.
 6. Pipe Supports: Roller, Strut clamps, Clevis hanger or Swivel hanger.
 7. Hardware: Galvanized or Stainless steel.
 8. Accessories: Protection pads.
 9. Height: 12 inches above roof.
- D. Pipe Stand - Single Base, Single Pipe, High Profile:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. MIRO Industries Inc.
 - b. PHP Systems/Design

2. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
3. Base: Single vulcanized rubber or molded polypropylene.
4. Vertical Members: Two, galvanized-steel or stainless steel, continuous-thread 1/2-inch rods.
5. Horizontal Member: One, adjustable-height, galvanized-steel or stainless steel pipe support slotted channel or plate.
6. Pipe Supports: Roller, Clevis hanger, or Swivel hanger.
7. Hardware: Galvanized or Stainless steel.
8. Accessories: Protection pads, 1/2-inch continuous-thread galvanized-steel rod or stainless steel rod.
9. Height: 36 inches above roof.

E. Pipe Stand - Multiple Pipe, High Profile:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. MIRO Industries Inc.
 - b. PHP Systems/Design
2. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
3. Bases: Two or more; vulcanized rubber or molded polypropylene.
4. Vertical Members: Two or more, galvanized-steel or stainless steel channels.
5. Horizontal Members: One or more, adjustable-height, galvanized-steel stainless steel pipe support.
6. Pipe Supports: Roller, Strut clamps, Clevis hanger, or Swivel hanger.
7. Hardware: Galvanized or Stainless steel.
8. Accessories: Protection pads, 1/2-inch continuous-thread rod.
9. Height: 36 inches above roof.

F. Pipe Stand - Curb-Mounted Type: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Aeroflex USA
 2. Buckaroos, Inc.
 3. Carpenter & Paterson, Inc
 4. KB Enterprise
 5. National Pipe Hanger Corporation
 6. Pipe Shields Inc.
 7. Piping Technology & Products, Inc
 8. Rilco Manufacturing Co., Inc
 9. Value Engineered Products, Inc
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psi minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100 psi, ASTM C552, Type II cellular glass with 100 psi, or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psi minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air

temperature.

2.9 FASTENER SYSTEMS

- A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Hilti, Inc.
- b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
- c. MKT Fastening, LLC

- B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. B-Line; a division of Eaton, Electrical Sector
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
- e. MKT Fastening, LLC

2. Indoor Applications: Zinc-plated or stainless steel.

3. Outdoor Applications: Stainless steel.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 EQUIPMENT STANDS, OUTDOOR TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. MIRO Industries Inc.
2. RectorSeal HVAC; a CSW Industrials Company

- B. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground- or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly-assembled on site.

C. Foot Material: Rubber or polypropylene.

D. Rails Material: Hot dip galvanized carbon steel.

E. Wind/Sliding Load Resistance: Up to 100 mph minimum.

2.12 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- 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 C1107/C1107M, 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 static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. 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.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. 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. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. 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.
- F. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with

- clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
 - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- G. 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.
- H. 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 in accordance with ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- J. Strut System Installation: Metal or FRP. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- K. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- L. Fastener System Installation:
- 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
 - 2. Install mechanical-expansion anchors after concrete is placed and completely cured.
 - 3. Install fasteners in accordance with manufacturer's written instructions.
 - 4. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
- M. 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.
- N. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- O. Equipment Support Installation:
 1. Fabricate from welded-structural-steel shapes.
 2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
 4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup:
 1. 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.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use FRP pipe hangers and FRP strut systems and corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron

- floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is 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.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Warning tape.
 4. Warning tags.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Champion America
 - d. Craftmark Pipe Markers
 - e. emedco
 - f. Kolbi Pipe Marker Co.
 - g. LEM Products Inc.
 - h. Marking Services Inc.
 - i. Pipemarker.com; Brimar Industries, Inc.
 - j. Seton Identification Products; a Brady Corporation company
 2. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch, or anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 3. Letter and Background Color: As indicated for specific application under Part 3.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
 6. Fasteners: Stainless steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Champion America

- d. Craftmark Pipe Markers
 - e. emedco
 - f. Kolbi Pipe Marker Co.
 - g. LEM Products Inc.
 - h. Marking Services Inc.
 - i. Pipemarket.com; Brimar Industries, Inc.
 - j. Seton Identification Products; a Brady Corporation company
 - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
 - 7. Fasteners: Stainless steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- 1. Brady Corporation
 - 2. Carlton Industries, LP
 - 3. Champion America
 - 4. Craftmark Pipe Markers
 - 5. emedco
 - 6. LEM Products Inc.
 - 7. Marking Services Inc.
 - 8. National Marker Company
 - 9. Pipemarket.com; Brimar Industries, Inc.
 - 10. Seton Identification Products; a Brady Corporation company
 - 11. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 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 the following:

1. Brady Corporation
2. Craftmark Pipe Markers
3. National Marker Company
4. Pipemarker.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company

- 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 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Brady Corporation
2. Champion America
3. Craftmark Pipe Markers
4. emedco
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Marking Services Inc.
8. Pipemarker.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company

- B. Description: Preprinted accident-prevention tags of plasticized card stock.

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. Letter and Background Color: As indicated for specific application under Part 3.

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.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes .
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 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.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
 - a. Constant-volume air systems.
2. Testing, adjusting, and balancing of equipment.
3. Testing, adjusting, and balancing of existing HVAC systems and equipment.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

1.3 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.
- B. 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.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by NEBB or TABB:
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.

2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner may 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.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, 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 heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance," ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" based on the agency through which the TAB specialist is certified] 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. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
 - 4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 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. Air curtains.
4. Terminal units.
5. Commercial kitchen hoods.
6. Furnaces.
7. Radiant heaters.
8. Unit heaters.
9. Heat exchangers.
10. Condensing units.
11. Energy-recovery units.
12. Air-handling units.
13. Heating and ventilating units.
14. Rooftop air-conditioning units.
15. Heating-only makeup air units.
16. Dedicated outdoor-air units.
17. Packaged air conditioners.
18. Self-contained air conditioners.
19. Computer-room air conditioners.
20. Split-system air conditioners.
21. Variable-refrigerant-flow systems.
22. Heat pumps.
23. Valance heating and cooling units.
24. Coils.
25. Fan coil units.
26. Unit ventilators.
27. Radiators.
28. Convectors.
29. Radiant-heating cables, piping, and panels.
30. Humidifiers.
31. Dehumidification units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' 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.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. 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.
 - 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 ,Owner, 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.

3.7 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. 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.

3.8 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.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Air pressure drop.
 5. Voltage and amperage input of each phase at full load.
 6. Calculated kilowatt at full load.
 7. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.
 3. Airflow.
 4. Air pressure drop.

5. Entering and leaving refrigerant pressure and temperatures.

3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
 2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
 3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 4. Check the refrigerant charge.
 5. Check the condition of filters.
 6. Check the condition of coils.
 7. Check the operation of the drain pan and condensate-drain trap.
 8. Check bearings and other lubricated parts for proper lubrication.
 9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.11 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. If design value is less than 100 cfm, within 10 cfm.
 2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 FINAL REPORT

A. TAB Report Data: Include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Report date.
6. Signature of TAB specialist who certifies the report.
7. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
8. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
9. Test conditions for fans performance forms, including the following if applicable:
 - 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.

B. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following if applicable:

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.

C. 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.

D. 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.
- k. Inlet steam pressure in psig.

E. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.

- c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and speed.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.
- F. 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.
- G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:

- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and 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.
- H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 1. Report Data:
 - a. System 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.
- I. Air-Terminal-Device Reports:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft..
 2. Test Data (Indicated and Actual Values):

- a. 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.

- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.

 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.

- K. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
 - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 - 7. Indoor, concealed oven and warewash exhaust.
 - 8. Indoor, exposed oven and warewash exhaust.
 - 9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 11. Outdoor, concealed supply and return.
 - 12. Outdoor, exposed supply and return.

1.2 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).

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- B. Coordinate installation and testing of heat tracing.

1.6 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534, Type II for sheet materials.
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
- G. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type II with factory-applied vinyl jacket, Type III with factory-applied FSK jacket and Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning

- H. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F. Comply with ASTM C553, Type V.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- I. Mineral Wool Blanket: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C553.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
- J. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ or factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- K. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- L. Mineral Wool Board: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1100 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
- M. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
 2. Semirigid board material with factory-applied ASJ or FSK jacket.
 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- N. Mineral Wool, Pipe and Tank: Mineral wool fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
 2. Semirigid board material with factory-applied ASJ or FSK jacket.
 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- O. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armacell LLC
 - b. Sekisui Voltek, LLC
 - c. Thermaduct

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 with ASTM C656, 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. 3M Building and Construction
 - c. CertainTeed; SAINT-GOBAIN
 - d. Thermal Ceramics
 - e. Unifrax Corporation

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to

itself and to surfaces to be insulated unless otherwise indicated.

- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. Childers Brand; H. B. Fuller Construction Products
 - d. Foster Brand; H. B. Fuller
 - e. K-Flex USA
 2. Adhesives shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Mon-Eco Industries, Inc.
 2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated in accordance with 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Mon-Eco Industries, Inc.
 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of 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 shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Consumer Solutions

- b. Johns Manville; a Berkshire Hathaway company
 - c. P.I.C. Plastics, Inc.
 - d. Proto Corporation
 - e. Sekisui Voltek, LLC
 - f. Speedline Corporation
2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of 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 shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
 1. VOC Content: 300 g/L or less.
 2. VOC Emissions: Mastic coatings shall contain no more than half of the chronic REL of VOCs when tested according to 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 shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Knauf Insulation
 - d. Vimasco Corporation
 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- C. Vapor-Retarder Mastic, Solvent Based, Interior Use: Suitable for indoor use on below ambient services.
 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Mon-Eco Industries, Inc.
 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 3. Service Temperature Range: 0 to 180 deg F.
- D. Vapor-Retarder Mastic, Solvent Based, Exterior Use: Suitable for outdoor use on below ambient services.
 1. Manufacturers: Subject to compliance with requirements, :
 - a. [Aeroflex USA

- b. Childers Brand; H. B. Fuller Construction Products
 - c. Eagle Bridges - Marathon Industries
 - d. Foster Brand; H. B. Fuller
 - 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Knauf Insulation
 - e. Mon-Eco Industries, Inc.
 - f. Vimasco Corporation
 - 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.

2.6 LAGGING ADHESIVES

- A. Lagging Adhesives: Compatible with insulation materials, jackets, and substrates.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Vimasco Corporation
 - 2. Adhesives shall have a VOC content of 50 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
 - 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 - 5. Service Temperature Range: 0 to plus 180 deg F.

2.7 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Mon-Eco Industries, Inc.
 - 2. Materials are compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.8 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 C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation
 - d. Speedline Corporation
 2. Adhesive: As recommended by jacket material manufacturer.
- D. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
 2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size].
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: heat-bonded polyethylene and kraft paper or 3-mil-thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 3-mil- thick polysurlyn.
 3. Stainless Steel Jacket: ASTM A240/A240M.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size].
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: heat-bonded polyethylene and kraft paper or 3-mil-thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 3-mil- thick polysurlyn.
- E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller
 - b. MFM Building Products Corp.
 - c. Polyguard Products, Inc.
- F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M
 - b. 3M Building and Construction
 - c. Foster Brand; H. B. FullerIdeal Tape Co., Inc., an American Biltrite Company
 2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
 3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - Foster Brand; H. B. Fuller
- B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - Vimasco Corporation

2.11 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: 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:
 - Alpha Associates, Inc.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Aeroflex USA
 - c. Avery Dennison Corporation, Specialty Tapes Division
 - d. Ideal Tape Co., Inc., an American Biltrite Company
 - e. Knauf Insulation
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division

- b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 - 2. Width:[3 inches.
 - 3. Thickness:[6.5 mils.
 - 4. Adhesion:[90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Ideal Tape Co., Inc., an American Biltrite Company
 - 2. Width: 2 inches .
 - 3. Thickness: 6 mils .
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 - e. Sekisui Voltek, LLC
 - 2. Width: 2 inches .
 - 3. Thickness: 3.7 mils .
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

- A. Bands:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
 - 2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch or 3/4 inch wide with wing seal or closed seal.
 - 3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch or 3/4 inch wide with wing seal or closed seal.
 - 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- or 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc
 - 2) Gemco
 - 3) Midwest Fasteners, Inc
 - 4) Nelson Stud Welding
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- or 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc
 - 2) CL WARD & Family Inc.
 - 3) Gemco
 - 4) Midwest Fasteners, Inc
 - 5) Nelson Stud Welding
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: copper- or zinc-coated, low-carbon steel, aluminum or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gemco.
 - 2) Midwest Fasteners, Inc.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to

bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: copper- or zinc-coated, low-carbon steel, aluminum or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, aluminum or stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc
 - 2) Gemco
 - 3) Midwest Fasteners, Inc
 - 4) Nelson Stud Welding
 - b. 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.
 - a. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1) Gemco
 - 2) Midwest Fasteners, Inc
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire Products
 - b. Johns Manville; a Berkshire Hathaway company
RPR Products, Inc.

2.14 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC in accordance with ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum in accordance with ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel in accordance with ASTM A240/A240M, 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 to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports,

anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.

- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC AND POLYOLEFIN INSULATION

- A. Comply with manufacturer's written installation instructions and ASTM C1710.
- B. 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.
- C. Square and Rectangular Ducts and Plenums:
 - 1. Provide 1/4 inch more per side for a tight, compression fit.
 - 2. Cut sheet insulation with the following dimensions:
 - a. Width of duct plus 1/4 inch, one piece.
 - b. Height of duct plus 1/4 inch, plus thickness of insulation, two pieces.
 - c. Width of duct plus 1/4 inch, plus two times the thickness of insulation, one piece.
 - 3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.
 - 4. Insulation without self-adhering backing:
 - a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last 1/4 inch where sheets will butt together.
 - b. Roll sheet down into position.
 - c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.
 - 5. Insulation with self-adhering backing:
 - a. Peel back release paper in 6- to 8-inch increments and line up sheet.
 - b. Press firmly to activate adhesive.
 - c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
 - d. Allow 1/4-inch overlap for compression at butt joints.
 - e. Apply adhesive at the butt joint to seal the two sheets together.
 - 6. Insulate duct brackets following manufacturer's written installation instructions.
- D. Circular Ducts:
 - 1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be

- used.
- 2. Cut the sheet to the required size.
- 3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
- 4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
- B. Comply with manufacturer's written installation instructions.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
 - 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 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 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.
- C. 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.
 - 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 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.

3.7 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, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- 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.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Comply with manufacturer's written installation instructions.
- B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- C. Insulate duct access panels and doors to achieve same fire rating as duct.
- D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.

5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

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.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation for concealed, round and flat-oval ducts must comply with local codes and ASHRAE 90.1 standards for the project climate zone and be of the following types and minimum thickness and nominal density values:
1. Flexible Elastomeric: 1 inch thick.
 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
 4. Polyolefin: 1 inch thick.
- B. Insulation for concealed or exposed, rectangular ducts and plenums must comply with local codes and ASHRAE 90.1 standards for the project climate zone and be of the following types and minimum thickness and nominal density values:
1. Flexible Elastomeric: 1 inch thick.
 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
 3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
 4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
 5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
 6. Polyolefin: 1 inch thick.
- C. Concealed or exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.
- D. Insulation for exposed, round and flat-oval ducts must comply with local codes and ASHRAE 90.1 standards for the project climate zone and be of the following types and minimum thickness and nominal density values:
1. Flexible Elastomeric: 1 inch thick.
 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
 3. Glass-Fiber Pipe and Tank: 1-1/2 inches thick.
 4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
 5. Mineral Wool Pipe and Tank: 1-1/2 inches thick.
 6. Polyolefin: 1 inch thick.

3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation for concealed, round and flat-oval ducts must comply with local codes and ASHRAE 90.1 standards for the project climate zone and be of the following types and minimum thickness and nominal density values:
 - 1. Glass-Fiber Blanket: 2 inches and 0.75 lb/cu. ft. nominal density.
 - 2. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
- B. Insulation for concealed or exposed, rectangular ducts and plenums must comply with local codes and ASHRAE 90.1 standards for the project climate zone and be of the following types and minimum thickness and nominal density values:
 - 1. Glass-Fiber Blanket: 2 inches and 0.75 lb/cu. ft. nominal density.
 - 2. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
 - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
 - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
- C. Insulation for exposed, round and flat-oval ducts must comply with local codes and ASHRAE 90.1 standards for the project climate zone and be of the following types and minimum thickness and nominal density values:
 - 1. Glass-Fiber Blanket: 2 inches and 0.75 lb/cu. ft. nominal density.
 - 2. Glass-Fiber Pipe and Tank: 1-1/2 inches thick.
 - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. > nominal density.
 - 4. Mineral Wool Pipe and Tank: 1-1/2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed or Exposed:
 - 1. None unless required by owner.
 - 2. PVC: 20 mils thick minimum.
 - 3. Aluminum: 0.016 inch thick minimum.
 - 4. Painted Aluminum: 0.016 inch thick minimum.
 - 5. Stainless Steel Type 304 or Type 316: 0.010 inch thick minimum.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. None unless required by owner
 - 2. PVC: 30 mils thick minimum.
 - 3. Aluminum: 0.024 inch thick minimum.
 - 4. Painted Aluminum: 0.024 inch thick minimum.
 - 5. Stainless Steel Type 304 or Type 316: 0.016 inch thick minimum.

- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. Aluminum: 0.024 inch thick minimum.
 2. Painted Aluminum: 0.024 inch thick minimum.
 3. Stainless Steel, Type 304 or Type 316: 0.016 inch thick minimum.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
1. Painted Aluminum with 2-1/2-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.040 inch thick minimum.
 2. Stainless Steel, Type 304 or Type 316, with 2-1/2-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.024 inch thick minimum.

END OF SECTION

SECTION 23 07 16

HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating HVAC equipment that is not factory insulated.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include the name of the manufacturer, fabricator, type, description, and size.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation.
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

1.6 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Breeching Insulation Schedule," "Indoor Equipment Insulation Schedule," and "Outdoor, Aboveground Equipment Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that contact stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I or Type II.
 1. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Johns Manville; a Berkshire Hathaway company
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Owens Corning
 2. Block Insulation: Type I.
 3. Special-Shaped Insulation: Type III.
 4. Board Insulation: Type IV.
 5. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 6. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type II for sheet materials.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
- I. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, , 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- J. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F. Comply with ASTM C553, Type V.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- K. Mineral Wool Blanket: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C553.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
- L. Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. Provide insulation with factory-applied ASJ or factory-applied FSK jacket]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- M. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- N. Mineral Wool Board: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1100 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
- O. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
 - 2. Semirigid board material with factory-applied ASJ or FSK jacket.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- P. Mineral Wool, Pipe and Tank: Mineral wool fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
 - 2. Semirigid board material with factory-applied ASJ or FSK jacket.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- Q. Polyisocyanurate: Prefabricated, rigid cellular polyisocyanurate material intended for use as thermal insulation. Comply with ASTM C591.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - 2. Type I or Type IV, except thermal conductivity (k-value) does not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
 - 3. Flame-spread index is 25 or less and smoke-developed index is 50 or less for thicknesses of up to 1.5 inches as tested in accordance with ASTM E84.
 - 4. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Equipment Applications: field-applied PVDC jacket
- R. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C1427, Type II, Grade 1 for sheet materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armacell LLC
- S. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C578, Type IV or VIII.
 - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

- a. Dow Chemical Co., sold through Polyguard Products, Inc.
 - b. Johns Manville; a Berkshire Hathaway company
2. Fabricate shapes in accordance with ASTM C450 and ASTM C585.

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ramco Insulation, Inc.
- C. Glass-Fiber and Mineral Wool, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ramco Insulation, Inc.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 - d. Vimasco Corporation
 2. Adhesive: As recommended by calcium silicate manufacturer and with a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products

- b. Foster Brand; H. B. Fuller
 - 2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- D. Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - 2. Adhesive: As recommended by phenolic and polyisocyanate manufacturer and with a VOC content of 50 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- E. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
 - 2. Adhesives shall have a VOC content of 50 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
 - 4. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
 - 5. Wet Flash Point: Below 0 deg F
 - 6. Service Temperature Range: 40 to 200 deg F.
- F. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 - 2. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

- G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 2. Adhesive: As recommended by polystyrene manufacturer and with a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- H. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Adhesives shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- I. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation
 - d. Speedline Corporation
 - e. The Dow Chemical Company
 2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.

1. Mastics shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor and outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Knauf Insulation
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation
 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 3. Service Temperature Range: 0 to 180 deg F.
- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Knauf Insulation
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation
 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.

2.6 LAGGING ADHESIVES

- A. Lagging Adhesives: Adhesives comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Vimasco Corporation
 2. Adhesive shall be as recommended by insulation manufacturer and shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
 5. Service Temperature Range: 0 to plus 180 deg F.

2.7 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 - d. Owens Corning
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 58 to plus 176 deg F.
 4. Sealant shall have a VOC content of 420 g/L or less.
 5. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Sealant shall have a VOC content of 420 g/L or less.
 5. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

D. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.8 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 C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation
 - d. Speedline Corporation
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Finish and thickness are indicated in field-applied jacket schedules.
 - b. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper, 3-mil- thick, heat-bonded polyethylene and kraft paper, or 3-mil- thick polysurlyn.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 3-mil- thick polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-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 A240/A240M.
 - a. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - b. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper, 3-mil- thick, heat-bonded polyethylene and kraft paper, or 3-mil- thick polysurlyn.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 3-mil- thick polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-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.
- E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with aluminum-foil facing.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MFM Building Products Corp.
 - b. Polyguard Products, Inc.
- F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M
 - b. Foster Brand; H. B. Fuller

- c. Ideal Tape Co., Inc., an American Biltrite Company
 - 2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
 - 3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
 - G. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - H. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 25 and a smoke-developed index of 50 when tested in accordance with ASTM E84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
- 2.10 FIELD-APPLIED FABRIC-REINFORCING MESH
- A. Woven Glass-Fiber Mesh: Approximately 4 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Vimasco Corporation
- 2.11 FIELD-APPLIED CLOTHS
- A. Woven Glass-Fiber Cloth: 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.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Ideal Tape Co., Inc., an American Biltrite Company
 - c.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation

2. Width: [2 inches] <Insert value>.
3. Thickness: [3.7 mils] <Insert value>.
4. Adhesion: [100 ounces force/inch] <Insert value> in width.
5. Elongation: [5] <Insert number> percent.
6. Tensile Strength: [34 lbf/inch] <Insert value> in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 psi in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
2. Width: 3 inches.
3. Film Thickness: 6 mils .
4. Adhesive Thickness: 1.5 mils .
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 psi in width.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch or 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch or 3/4 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding; 0.106-inch- or 0.135-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Manufacturers: Subject to compliance with requirements, provide provide products by one of the following:

- 1) AGM Industries, Inc
 - 2) Gemco
 - 3) Midwest Fasteners, Inc
 - 4) Nelson Stud Welding
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding; 0.106-inch- or 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc
 - 2) CL WARD & Family Inc.
 - 3) Gemco
 - 4) Midwest Fasteners, Inc
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. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1) AGM Industries, Inc
 - 2) Gemco
 - 3) Midwest Fasteners, Inc
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank; length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Use 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gemco
 - 2) Midwest Fasteners, Inc
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank; length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Use 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) AGM Industries, Inc
 - 2) Gemco
 - 3) Midwest Fasteners, Inc
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed; 0.106-inch- diameter shank; length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, aluminum or stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc
 - 2) Gemco
 - 3) Midwest Fasteners, Inc
 - 4) Nelson Stud Welding
 - b. 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: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire Products
 - b. Johns Manville; a Berkshire Hathaway company
 - c. RPR Products, Inc.

2.14 CORNER ANGLES

- A. PVC Corner Angles: 30-mils- thick, minimum 1- by 1-inch PVC in accordance with ASTM D1784, Class 16354-C, white or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040-inch- thick, minimum 1- by 1-inch aluminum in accordance with ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless Steel Corner Angles: 0.024-inch- thick, minimum 1- by 1-inch stainless steel in accordance with ASTM A240/A240M, 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. 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 of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, and jackets, of thicknesses required for each item of equipment, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 4. For below-ambient services, apply vapor-barrier mastic over staples.
 5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- O. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral Wool or Glass-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive, anchor pins, and speed washers.
1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 75 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 compress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins, and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch 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 and replaceable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with 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 field-adjustable latching mechanism.
 2. Fabricate boxes from galvanized steel, aluminum or stainless steel, at least 0.040 inch, 0.050 inch or 0.060 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.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

- A. 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Install in accordance with manufacturer's written installation instructions and ASTM C1710.
- B. 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.

3.7 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, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- 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.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - 2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

- A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each type of equipment defined in "Indoor Equipment Insulation Schedule" and "Outdoor, Aboveground Equipment Insulation Schedule" articles. For large equipment, remove only a portion adequate to determine compliance.
- B. All insulation applications will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 EQUIPMENT INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable 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 is Contractor's option.

3.11 BREECHING INSULATION SCHEDULE

- A. Round, exposed breeching and connector insulation is one of the following:
 - 1. Calcium Silicate: 4 inches thick.
 - 2. High-Temperature Glass-Fiber Blanket: 3 inches thick and 3 lb/cu. ft. nominal density.
 - 3. Mineral Wool Blanket: 3 inches thick and 4 lb/cu. ft. nominal density.
- B. Round, concealed breeching and connector insulation is one of the following:
 - 1. Calcium Silicate: 4 inches thick.
 - 2. High-Temperature Glass-Fiber Blanket: 3 inches thick and 3 lb/cu. ft. nominal density.
 - 3. Mineral Wool Blanket: 3 inches thick and 4 lb/cu. ft. nominal density.
- C. Rectangular, exposed breeching and connector insulation is one of the following:
 - 1. Calcium Silicate: 4 inches thick.
 - 2. High-Temperature Glass-Fiber Blanket: 3 inches thick and 3 lb/cu. ft. nominal density.
 - 3. High-Temperature Glass-Fiber Board: 3 inches thick and [3 lb/cu. ft.] [6 lb/cu. ft.] nominal density.
 - 4. Mineral Wool Blanket: 3 inches thick and 4 lb/cu. ft. nominal density.
 - 5. Mineral Wool Board: 3 inches thick and 4 lb/cu. ft. or 6 lb/cu. ft. nominal density.
- D. Rectangular, concealed breeching and connector insulation is one of the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Glass-Fiber Blanket: 3 inches thick and 3 lb/cu. ft. nominal density.
3. High-Temperature Glass-Fiber Board: 3 inches thick and 3 lb/cu. ft. or 6 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 3 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 3 inches thick and 4 lb/cu. ft. or 6 lb/cu. ft. nominal density.

3.12 INDOOR EQUIPMENT INSULATION SCHEDULE

- A. Insulate indoor and outdoor equipment that is not factory insulated.

3.13 OUTDOOR, ABOVEGROUND EQUIPMENT INSULATION SCHEDULE

- A. Retain "one of" option in paragraph below to allow Contractor to select materials from those retained. Heated, fuel-oil storage tank insulation is [one of] the following:

1. Cellular Glass: 3 inches thick.
2. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. minimum nominal density.
3. Glass-Fiber Pipe and Tank: 2 inches thick.
4. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. minimum nominal density.
5. Mineral Wool Pipe and Tank: 2 inches thick.
6. Polyisocyanurate: 1-1/2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Equipment, Concealed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum: 0.016 inch thick.
4. Painted Aluminum: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316: 0.010 inch thick.

- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces of up to 72 Inches:

1. None.
2. PVC: 20 mils thick.
3. Aluminum: 0.016 inch thick.
4. Painted Aluminum: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316: 0.010 inch thick.

- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. None.
2. Aluminum with 1-1/4-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.032 inch thick.
3. Stainless Steel, Type 304 or Type 316, with 1-1/4-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.020 inch thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. PVC: 30 mils thick.
 - 2. Aluminum: 0.024 inch thick.
 - 3. Painted Aluminum: 0.024 inch thick.
 - 4. Stainless Steel, Type 304 or Type 316: [0.016 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces of up to 72 Inches:
 - 1. Painted Aluminum with Z-Shaped Locking Seam: 0.024 inch thick.
 - 2. Stainless Steel, Type 304 or Type 316, with Z-Shaped Locking Seam: 0.016 inch thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. Painted Aluminum, with 1-1/4-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.032 inch thick.
 - 2. Stainless Steel, Type 304 or Type 316, with 1-1/4-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.020 inch thick.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulation for HVAC piping systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.4 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.5 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authority having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate: Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I.
 - 1. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
 - a. Manufacturers: Subject to compliance with requirements provide products by the following:
 - 1) Aeroflex USA
 - 2) Johns Manville; a Berkshire Hathaway company
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Owens Corning
 - 2. Preformed Pipe Insulation without Jacket: Type II, Class 1, unfaced.
 - 3. Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied ASJ, ASJ-SSL, ASJ+ or PSK jacket.
 - 4. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
 - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
- I. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Knauf Insulation

- c. Manson Insulation Inc.
 - d. Owens Corning
 - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ or factory-applied PSK jacket].
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
 - 2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ or factory-applied PSK jacket].
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
- K. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
 - 2. Semirigid board material with factory-applied ASJ, FSK, ASJ+ or PSK jacket.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- L. Mineral Wool, Pipe and Tank: Mineral wool fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Owens Corning
 - c. ROCKWOOL
 - 2. Semirigid board material with factory-applied ASJ, FSK, ASJ+ or PSK jacket.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- M. Phenolic: Prefabricated pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Polyguard Products, Inc.
 - b. Resolco Inc.
 - 2. Prefabricated Pipe Insulation: Type III with factory-applied ASJ or factory-applied PSK jacket.
 - 3. Prefabricated shapes in accordance with ASTM C450 and ASTM C585.

4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- N. Polyisocyanurate: Prefabricated, rigid cellular polyisocyanurate material intended for use as thermal insulation. Comply with ASTM C591.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 2. Prefabricated insulation with factory-applied ASJ or ASJ-SSL or with field-applied PVDC jacket or PVDC-SSL.
 3. Type IV, except thermal conductivity (k-value) do not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
 4. Flame-spread index is 25 or less, and smoke-developed index is 50 or less for thicknesses of up to 1.5 inch as tested in accordance with ASTM E84.
 5. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 6. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- O. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C1427, Type I, Grade 1, for tubular materials and with Type II, Grade 1, for sheet materials.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armacell LLC
 - b. Sekisui Voltek, LLC
- P. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C578, Type I-XII for board or Type XIII for pipe insulation, except thermal conductivity (k-value) do not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes in accordance with ASTM C450 and ASTM C585.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Dow Chemical Co., sold through Polyguard Products, Inc.
 - b. Johns Manville; a Berkshire Hathaway company

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
- C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 - d. Vimasco Corporation
 - 2. Adhesive: As recommended by calcium silicate manufacturer and with a VOC content of 50 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Foster Brand; H. B. Fuller
 - 2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- D. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c.
 - 2. Adhesive: As recommended by phenolic and polyisocyanate manufacturer and with a VOC content of 50 g/L or less.
 - 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- E. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
 2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
 4. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
 5. Wet Flash Point: Below 0 deg F.
 6. Service Temperature Range: 40 to 200 deg F.
- F. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 2. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- H. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 2. Adhesives shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of

formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

I. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation
 - d. Sekisui Voltek, LLC
 - e. Speedline Corporation
 - f. The Dow Chemical Company
2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
2. Mastics shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Knauf Insulation
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation
2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 3. Service Temperature Range: 0 to 180 deg F.
- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Aeroflex USA
 - b. Childers Brand; H. B. Fuller Construction Products
 - c. Foster Brand; H. B. Fuller
 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Knauf Insulation
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation
 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 3. Service Temperature Range: 0 to plus 180 deg F.

2.6 LAGGING ADHESIVES

- A. Lagging Adhesives: Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Vimasco Corporation
 2. Adhesive shall be as recommended by insulation manufacturer and shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 5. Service Temperature Range: 20 to plus 180 deg F.

2.7 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
 - d. Owens Corning
2. Permanently flexible, elastomeric sealant.
 - a. Service Temperature Range: Minus 150 to plus 250 deg F.
3. Sealant shall have a VOC content of 420 g/L or less.
4. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 - c. Mon-Eco Industries, Inc.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

D. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.8 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 C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
5. PSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Airex Manufacturing Inc.
 - b. Johns Manville; a Berkshire Hathaway company
 - c. P.I.C. Plastics, Inc.
 - d. Proto Corporation
 - e. Speedline Corporation
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
 2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size].
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor or Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 53-mil- thick polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-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 A240/A240M.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor or Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 3-mil- thick polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-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.
 - E. 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 the following:
 - a. Owens Corning
 - b. Polyguard Products, Inc.
 - F. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with aluminum-foil facing.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. MFM Building Products Corp.
 - b. Polyguard Products, Inc.
 - G. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M
 - b. Foster Brand; H. B. Fuller
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
 3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
 - H. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - I. Johns Manville; a Berkshire Hathaway companyPVDC Jacket for Outdoor Applications: 6-mil- thick, white

PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 25 and a smoke-developed index of 50 when tested in accordance with ASTM E84.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Johns Manville; a Berkshire Hathaway company

J. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Johns Manville; a Berkshire Hathaway company

2.10 FIELD-APPLIED FABRIC REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand; H. B. Fuller Construction Products

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Childers Brand; H. B. Fuller Construction Products
- b. Foster Brand; H. B. Fuller
- c. Vimasco Corporation

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: 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 the following:

a. Alpha Associates, Inc.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. 3M Industrial Adhesives and Tapes Division
- b. Aeroflex USA
- c. Avery Dennison Corporation, Specialty Tapes Division
- d. Ideal Tape Co., Inc., an American Biltrite Company
- e. Knauf Insulation

2. Width: 3 inches .
 3. Thickness: 11.5 mils .
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 2. Width: 3 inches .
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Ideal Tape Co., Inc., an American Biltrite Company
 - c.
 2. Width: 2 inches .
 3. Thickness: 6 mils .
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 2. Width: 2 inches .
 3. Thickness: 3.7 mils .
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company

2. Width: 3 inches.
3. Film Thickness: 2 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 120 percent.
6. Tensile Strength: 20 psi in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 psi in width.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire Products
 - b. Johns Manville; a Berkshire Hathaway company
 - c. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. 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.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of 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, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.
- 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 attached to structure with vapor-barrier mastic.
3. Install insert materials and 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, but not to the extent of creating wrinkles or areas of compression in the insulation.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 4. For below-ambient services, apply vapor-barrier mastic over staples.
 5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 6. 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.
- 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 in similar fashion 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.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal

- with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using prefabricated fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is 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 prefabricated fitting insulation or sectional pipe insulation of same material and thickness as that 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 prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 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 reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and

polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

- 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. Installation conforms 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 that of adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF 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 prefabricated 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 that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
 - 4. Finish flange insulation same as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When prefabricated 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 pipe insulation, quads, hex sections, or beveled lag segments, adhered together, 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.

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 jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated 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 that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
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 prefabricated sections of same material as that of 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 or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated 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 that of 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 sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
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 prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL 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 jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool 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 prefabricated sections of same material as that of 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated 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.

3.10 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets with vapor retarder on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install prefabricated 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 that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated insulation sections, or mitered or routed fittings, of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 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 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 is 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 prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, and same thickness as that 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 that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

C. Insulation Installation on Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated 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.

3.12 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive or via self-seal mechanism to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to

eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.13 INSTALLATION OF POLYSTYRENE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with 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 is 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 prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts and make thickness same as that of adjacent pipe insulation, not to exceed 1-1/2 inches.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness that of as pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated section of polystyrene 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.

3.14 INSTALLATION OF FIELD-APPLIED JACKETS

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 and for horizontal applications, 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.
- E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap presized jackets around individual pipe insulation sections, with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.15 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.16 FIELD QUALITY CONTROL

- A. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.17 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. 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.
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.18 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyisocyanurate: 1 inch thick.
 - g. Polyolefin: 3/4 inch thick.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
 - e. Phenolic: 1 inch thick.
 - f. Polyisocyanurate: 1 inch thick.
 - g. Polyolefin: 1 inch thick.
- C. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation is one of the following:

- a. Flexible Elastomeric: 2 inches thick.
- b. Polyolefin: 2 inches thick.

D. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.
- c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
- e. Phenolic: 1 inch thick.
- f. Polyisocyanurate: 1 inch thick.
- g. Polyolefin: 1 inch thick.

E. Heat-Recovery Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.
- c. Glass-Fiber, Preformed Pipe Insulation, Type I, or Pipe and Tank Insulation: 1 inch thick.
- d. Mineral Wool, Preformed Pipe Insulation, Type II, or Pipe and Tank Insulation: 1 inch thick.
- e. Phenolic: 1 inch thick.
- f. Polyisocyanurate: 1 inch thick.
- g. Polyolefin: 1 inch thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Cellular Glass: 2 inches thick.
- b. Flexible Elastomeric: 2 inches thick.
- c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
- e. Phenolic: 2 inches thick.
- f. Polyisocyanurate: 2 inches thick.
- g. Polystyrene: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is the following:

- a. Flexible Elastomeric: 2 inches thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Flexible Elastomeric: 1 inch thick.
- b. Polyolefin: 1 inch thick.

D. Heat-Recovery Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Cellular Glass: 2 inches thick.
- b. Flexible Elastomeric: 2 inches thick.
- c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
- e. Phenolic: 2 inches thick.
- f. Polyisocyanurate: 2 inches thick.
- g. Polystyrene: 2 inches thick.

3.20 OUTDOOR, UNDERGROUND, PIPING INSULATION SCHEDULE

- A. Insulation for belowground piping is specified in Section 232113.13 "Underground Hydronic Piping" and Section 232213.13 "Underground Steam and Condensate Heating Piping."

3.21 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 30 mils thick.
 - 3. Aluminum: [0.024 inch thick.
 - 4. Painted Aluminum: 0.024 inch thick.
 - 5. Stainless Steel, Type 304 or Type 316: [0.016 inch thick.
 - 6. Piping, Exposed:
 - 7. PVC: 40 mils thick.
 - 8. Aluminum with Z-Shaped Locking Seam: [0.024 inch thick.
 - 9. Stainless Steel, Type 304 or Type 316 with Z-Shaped Locking Seam: 0.016 inch thick.

3.22 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Valves and specialties.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Strainers.
5. Filter dryers.
6. Pressure-regulating valves.
7. Mufflers.

B. Product Data Submittals: For each product.

1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

B. Prepare valves and specialties for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads and other end connections.

C. Use the following precautions during storage:

1. Maintain valve and specialty end protection.
2. Store valves and specialties indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASHRAE 15.

- B. Comply with ASME B31.5.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B88, Type K or L or ASTM B280, 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 B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- F. Brazing Filler Metals: AWS A5.8M/A5.8.
- 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.
- H. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Conex Banninger - USA
 - b. Mueller Streamline Co.; a company of Mueller Industries
 - c. Parker Hannifin; Sporlan Division (Zoomlock)
 - d. RLS LLC
 - 2. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
 - 3. Housing: Copper.
 - 4. O-Rings: HNBR compatible with specific refrigerant.
 - 5. Tools: Manufacturer's approved special tools.
 - 6. Minimum Rated Pressure: 700 psig.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.
- B. Wrought-Steel Fittings: ASTM A234/A234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5 steel, including bolts, nuts, gaskets, bevel-welded end connection, and raised face.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 and ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Flanged Unions:

1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Factory apply rust-resistant finish.
2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Factory apply rust-resistant finish.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
6. Pressure Rating: Factory test at minimum 400 psig.
7. Maximum Operating Temperature: 330 deg F.

F. Flexible Connectors:

1. Body: Stainless steel bellows with woven, flexible, stainless steel-wire-reinforced protective jacket.
2. End Connections:
 - a. NPS 2 and Smaller: With threaded-end connections.
 - b. NPS 2-1/2 and Larger: With flanged-end connections.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.4 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. [Parker (Parker Hannifin)]
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: [240 deg F.

B. Packed-Angle Valves:

1. Manufacturers: Subject to compliance with requirements, :
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. Parker (Parker Hannifin)
2. Body and Bonnet: Forged brass or cast bronze.
3. Packing: Molded stem, back seating, and replaceable under pressure.
4. Operator: Rising stem.
5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
6. Seal Cap: Forged-brass or valox hex cap.
7. End Connections: Socket, union, threaded, or flanged.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Danfoss, Inc.
 - c. Emerson Climate Technologies; Emerson Electric Co.
 - d. Henry Technologies Inc.; The Henry Group
 - e. Parker (Parker Hannifin)
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 .

D. Service Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group
 - d. JB Industries
 - e. Parker (Parker Hannifin)
 - f. RectorSeal HVAC; a CSW Industrials Company
 - g. 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.
7. Maximum Operating Temperature: 275 deg F.

E. Refrigerant Locking Caps:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & D Valve, LLC
 - b. JB Industries
 - c. RectorSeal HVAC; a CSW Industrials Company
 - d. Refrigeration Sales, Inc.
2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant-charging ports from unauthorized refrigerant access and leakage.
3. Material: Brass, with protective shroud or sleeve.
4. Special Tool: For installing and unlocking.

F. Solenoid Valves: Comply with AHRI 760 I-P and UL 429; listed and labeled by an NRTL.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group

- d. Parker (Parker Hannifin)
 - 2. Body and Bonnet: Plated steel.
 - 3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - 4. Seat: Polytetrafluoroethylene.
 - 5. End Connections: Threaded.
 - 6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter.
 - 7. Working Pressure Rating: 400 psig .
 - 8. Maximum Operating Temperature: 240 deg F.
- G. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. Parker (Parker Hannifin)
 - 2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 - 3. Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 4. Seat: Polytetrafluoroethylene.
 - 5. End Connections: Threaded.
 - 6. Working Pressure Rating: 400 psig.
 - 7. Maximum Operating Temperature: 240 deg F .
- H. Thermostatic Expansion Valves: Comply with AHRI 750 I-P.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group
 - d. Parker Hannifin; Sporlan Division (Zoomlock)
 - 2. Body, Bonnet, and Seal Cap: Forged brass or steel.
 - 3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 4. Packing and Gaskets: Non-asbestos.
 - 5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 - 6. Suction Temperature: 40 deg F.
 - 7. Reverse-flow option (for heat-pump applications).
 - 8. End Connections: Socket, flare, or threaded union.
 - 9. Working Pressure Rating: 700 psig.
- I. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. Parker (Parker Hannifin)
 - d.
 - 2. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 - 3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 4. Packing and Gaskets: Non-asbestos.
 - 5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - 6. Seat: Polytetrafluoroethylene.

7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and [24] [115] [208] V ac coil.
8. End Connections: Socket.
9. Throttling Range: Maximum 5 psig.
10. Working Pressure Rating: 500 psig >.
11. Maximum Operating Temperature: 240 deg F .

J. Straight-Type Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. Parker (Parker Hannifin)
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 .

K. Angle-Type Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. Parker (Parker Hannifin)
2. Body: Forged brass or cast bronze.
3. Drain Plug: Brass hex plug.
4. Screen: 100-mesh monel.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F .

L. Moisture/Liquid Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group
 - d. Parker (Parker Hannifin)
 - e. RLS LLC
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.

M. Replaceable-Core Filter Dryers: Comply with AHRI 730 I-P.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.

- b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group
 - d. Parker (Parker Hannifin)
 - 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. Design: Reverse flow (for heat-pump applications).
 - 5. End Connections: Socket.
 - 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 - 7. Maximum Pressure Loss: 2 psig].
 - 8. Working Pressure Rating: 500 psig .
 - 9. Maximum Operating Temperature: 240 deg F .
- N. Permanent Filter Dryers: Comply with AHRI 730 I-P.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group
 - d. arker (Parker Hannifin)
 - e. [RLS LLC
 - 2. Body and Cover: Painted-steel shell.
 - 3. Filter Media: 10 micron, pleated with integral end rings; stainless steel support.
 - 4. Design: Reverse flow (for heat-pump applications).
 - 5. End Connections: Socket.
 - 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 - 7. Maximum Pressure Loss: 2 psig .
 - 8. Working Pressure Rating: 500 psig.
 - 9. Maximum Operating Temperature: 240 deg F.
- O. Mufflers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Danfoss, Inc.
 - b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group]
 - d. Parker Hannifin; Sporlan Division (Zoomlock)
 - 2. Body: Welded steel with corrosion-resistant coating.
 - 3. End Connections: Socket or flare.
 - 4. Working Pressure Rating: 500 psig .
 - 5. Maximum Operating Temperature: 275 deg F.
- P. Receivers: Comply with AHRI 495.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Henry Technologies Inc.; The Henry Group
 - b. Parker Hannifin; Sporlan Division (Zoomlock)
 - 2. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 - 3. Comply with UL 207; listed and labeled by an NRTL.
 - 4. Body: Welded steel with corrosion-resistant coating.

5. Tappings: Inlet, outlet, liquid-level indicator, and safety-relief valve.
6. End Connections: Socket or threaded.
7. Working Pressure Rating: 450 psig.
8. Maximum Operating Temperature: 250 deg F.

Q. Liquid Accumulators: Comply with AHRI 495.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Emerson Climate Technologies; Emerson Electric Co.
 - b. Henry Technologies Inc.; The Henry Group
 - c. Parker (Parker Hannifin)
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or threaded.
4. Working Pressure Rating: [500 psig] <Insert pressure>.
5. Maximum Operating Temperature: [275 deg F] <Insert temperature>.

PART 3 - EXECUTION

3.1 PIPING APPLICATION SCHEDULES

- A. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 4 (DN 100) and Smaller: Copper, Type ACR or Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Safety-Relief-Valve Discharge Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, Copper: Type ACR, Type K, or Type L, drawn-temper or annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- D. Safety-Relief-Valve Discharge Piping for Conventional Air-Conditioning (Cooling-Only) Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.
- E. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- F. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 4 (DN 100) and Smaller: Copper, Type ACR or Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- G. Safety-Relief-Valve Discharge Tubing for Heat-Pump Applications, Copper: Type ACR, Type K, or Type L, drawn-temper or annealed-temper tubing and wrought-copper fittings with brazed or soldered joints

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.
- B. 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.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

- D. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety-relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside in accordance with ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.
- N. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to authority having jurisdiction.

3.3 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 in accordance with 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 or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, 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 in accordance with Section 230553 "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 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 in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."
 - 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.

- E. Threaded Joints: Thread steel pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and to restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- G. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 ft. long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 ft. or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 ft. 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.
- B. Install hangers for copper tubing and steel 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.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper tubing and steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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 thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves but not bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces:** Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- B. ASHRAE Compliance:** Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- C. ASHRAE/IES Compliance:** Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- D. Duct Dimensions:** Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

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.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

- B. Transverse Joints: Fabricate joints in accordance with 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."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with 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."
 - 1.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 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 the following] [provide products by one of the following:
 - 1. McGill AirFlow LLC
 - 2. MKT Metal Manufacturing
 - 3. SHAPE Manufacturing Inc.
 - 4. Sheet Metal Connectors, Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of 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.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct outer duct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- D. Transverse Joints: Select joint types and fabricate in accordance with 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."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- E. Longitudinal Seams: Select seam types and fabricate in accordance with 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: Duct liner complying with ASTM C1071, 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.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, 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 24-gauge perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

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," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Elgen Manufacturing
 - 2. GreenSeam
 - 3. Linx Industries; a DMI company (formerly Lindab)
 - 4. McGill AirFlow LLC
 - 5. MKT Metal Manufacturing
 - 6. Nordfab Ducting
 - 7. SEMCO, LLC; part of FlaktGroup
 - 8. Set Duct Manufacturing
 - 9. SHAPE Manufacturing Inc.
 - 10. Sheet Metal Connectors, Inc.
 - 11. Spiral Manufacturing Co., Inc.
 - 12. Stamped Fittings Inc
- C. 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).
- D. Transverse Joints: Select joint types and fabricate in accordance with 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."
- E. Longitudinal Seams: Select seam types and fabricate in accordance with 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.

- F. Tees and Laterals: Select types and fabricate in accordance with 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 the following]:
1. Linx Industries; a DMI company (formerly Lindab)
 2. McGill AirFlow LLC
 3. MKT Metal Manufacturing
 4. SEMCO, LLC; part of FlaktGrou
 5. Set Duct Manufacturing
 6. SHAPE Manufacturing Inc.
 7. Sheet Metal Connectors, Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 2. For ducts exposed to weather, construct outer duct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
 3. Transverse Joints: Select joint types and fabricate in accordance with 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.
 4. Longitudinal Seams: Select seam types and fabricate in accordance with 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.
 5. Tees and Laterals: Select types and fabricate in accordance with 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 24-gauge perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, 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.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, 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.

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 are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G60.
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

E. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.
2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.

I. 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. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Owens Corning
 - e. Sekisui Voltek, LLC
2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
 - a. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
 - d. Sekisui Voltek, LLC
2. Source Limitations: Obtain flexible elastomeric duct liner from single manufacturer.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. Adhesive shall have a VOC content of 80 g/L or less.
 - b. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. Fibrous-Glass-Free, Natural-Fiber Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with

antimicrobial coating.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Acoustical Surfaces, Inc.
 - b. Ductmate Industries, Inc; a DMI company
 2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. Adhesive shall have a VOC content of 80 g/L or less.
 - b. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- D. Polyolefin Duct Liner: Cross-linked, partially open-cell polyolefin foam sheet or roll materials, with reinforced aluminum foil facing and adhesive backing, complying with NFPA 90A or NFPA 90B; sheet (Type II) complying with ASTM C1427.
1. Manufacturers: Subject to compliance with requirements, provide products by the following] [
 - a. Sekisui Voltek, LLC
 2. Foam Core Density: 1.5 pcf.
 3. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
 4. Minimum Noise Reduction Coefficient (NRC): 0.50 for 3/8-inch thickness, 0.45 for 5/8-inch thickness, 0.55 for 1-inch thickness, 0.55 for 2-1/8-inch thickness.
 5. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
 6. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. Adhesive shall have a VOC content of 80 g/L or less.
 - b. Adhesive shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- E. 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, aluminum, or stainless steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.
- F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage

- at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Sealant: Modified styrene acrylic.
 3. Water resistant.
 4. Mold and mildew resistant.
 5. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 6. Service: Indoor and outdoor.
 7. Service Temperature: Minus 40 to plus 200 deg F.
 8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 9. Sealant shall have a VOC content of 420 g/L or less.
 10. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Sealant shall have a VOC content of 420 g/L or less.
9. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply 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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct

Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in 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 TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

- A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.
- B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- C. All ducts exposed to view are to be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view are to be stainless or carbon steel as per "Duct Schedule" Article.
- D. All joints are to be welded and are to be telescoping, bell, or flange joint as per NFPA 96.
- E. 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.
- F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

- A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.
- B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.
- C. Minimize number of transverse seams.
- D. Do not locate longitudinal seams on bottom of duct.

3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS

- A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."
- B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.
- C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.

3.6 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
- C. Single Wall:
 - 1. Ductwork is to be Type 304 or Type 316 stainless steel.
 - 2. Ductwork is to be galvanized steel.
 - a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."
 - 3. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."
- D. Double Wall:
 - 1. Ductwork complies with requirements in "Double-Wall Rectangular Ducts and Fittings" or "Double-Wall Round and Flat-Oval Ducts and Fittings" Article.
 - 2. Ductwork outer wall is to be Type 304 Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
 - 3. Provide interstitial insulation.

3.7 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.8 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.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.9 DUCTWORK 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.

3.10 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner.

Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
2. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior or stainless steel

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, Terminal Units, and other comparable low-pressure systems:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 2.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.
2. Ducts Connected to Constant-Volume Air-Handling Units :
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.
3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, Terminal Units, and other comparable low-pressure systems:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.
2. Ducts Connected to Air-Handling Units :
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

- a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.
 2. Ducts Connected to Air-Handling Units <Insert equipment>:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and B if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.
 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless steel sheet.
 - b. Concealed: [Type 304, stainless steel sheet or Carbon-steel sheet.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 4-inch wg.
 - e. Airtight/watertight.
 4. Ducts Connected to Dishwashers, Dishwasher Hoods, and Other High-Humidity Locations:
 - a. Type 304, stainless steel sheet.
 - b. Welded longitudinal seams; welded or flanged transverse joints with watertight EPDM gaskets.
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Airtight/watertight.
 5. Ducts Connected to Fans Exhausting Fume Hood, Laboratory, and Process (ASHRAE 62.1, Class 3 and Class 4) Air:
 - a. Type 316, stainless steel sheet.
 - b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
 - c. Pressure Class: Positive or negative 6-inch wg.
 - d. Minimum SMACNA Seal Class A or Welded seams and joints.
 - e. SMACNA Leakage Class 2.
 - f. Airtight/watertight.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, Terminal Units and other comparable low-pressure systems:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 16.
- F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 2. PVC-Coated Ducts:

- a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
- 3. Stainless Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
- 4. Aluminum Ducts: Aluminum
- G. Liner:
 - 1. Fibrous glass, Type I, Flexible elastomeric, Fibrous-glass-free, natural fiber, or Polyolefin, minimum 1-1/2 inch thick.
- H. Double-Wall Duct Interstitial Insulation:
 - 1. Minimum 1-1/2 inch thick.
- I. Elbow Configuration:
 - 1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC

Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

- 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
- 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- 4) Radius-to Diameter Ratio: 1.5.

J. 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: Conical spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling radiation dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Duct silencers.
12. Turning vanes.
13. Remote damper operators.
14. Duct-mounted access doors.
15. Duct access panel assemblies.
16. Flexible connectors.
17. Duct security bars.
18. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.**
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable**

materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. American Warming and Ventilating (AWV); Mestek, Inc.
2. Cesco Products; MESTEK, Inc.
3. Greenheck Fan Corporation
4. Lloyd Industries, Inc.
5. Nailor Industries Inc
6. Pottorff
7. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
8. Safe Air - Dowco
9. United Enertech Corp.
10. Vent Products Co., Inc

B. Description: Gravity balanced.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:
 - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
 - d. Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.

D. Construction:

1. Frame:
 - a. Hat shaped.
 - b. 16-gauge- thick, galvanized sheet steel, 0.093-inch- thick extruded aluminum, or 18-gauge- thick stainless steel, with welded or mechanically attached corners and mounting flange.
2. Blades:
 - a. Multiple single-piece blades.
 - b. Maximum 6-inch width, with sealed edges.
3. Blade Action: Parallel.

E. Return Spring: Adjustable tension.

F. Damper Actuator - Electric:

1. UL 873 plenum rated.
2. Fully modulating with fail-safe spring return.
 - a. Sufficient motor torque and spring torque to drive damper fully closed with adequate force to achieve required damper seal.

- b. Minimum 90-degree drive rotation.
 - 3. Clockwise or counterclockwise drive rotation as required for application.
 - 4. Environmental Operating Range:
 - a. Temperature: Minus 40 to plus 130 deg F.
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
 - 5. Environmental Enclosure: NEMA 2.
 - 6. Actuator to be factory mounted and provided with a single-point wiring connection.
- G. Controllers, Electrical Devices, and Wiring:
- H. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Chain pulls.
 - 4. Screen Mounting:
 - a. Mounted in sleeve.
 - 1) Sleeve Thickness: 20 gauge minimum.
 - 2) Sleeve Length: 6 inches minimum.
 - 5. Screen Material: Galvanized steel or Aluminum.
 - 6. Screen Type: Bird.
 - 7. 90-degree stops.

2.3 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. American Warming and Ventilating (AWV); Mestek, Inc.
 - 2. Cesco Products; MESTEK, Inc.
 - 3. Greenheck Fan Corporation
 - 4. Lloyd Industries, Inc.
 - 5. Nailor Industries Inc
 - 6. Pottorff
 - 7. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - 8. Safe Air - Dowco
 - 9. United Enertech Corp.
 - 10. Vent Products Co., Inc
- B. General Requirements:
 - 1. Suitable for horizontal or vertical mounting.
- C. Construction:
 - 1. Frame: Hat shaped, 16-gauge- thick, galvanized sheet steel, 0.093-inch- thick extruded aluminum, or 18-gauge- thick stainless steel, with welded corners or mechanically attached and mounting flange.
 - 2. Blades:

- a. Multiple, 16-gauge- thick, galvanized sheet steel, 0.050-inch- thick aluminum sheet, or 26-gauge Type 304 stainless steel.
- b. Maximum Width: 6 inches.
- c. Action: Parallel.
- d. Balance: Gravity.

3. Tie Bars and Brackets:

- a. Material: Aluminum or Galvanized steel.
- b. Rattle free with 90-degree stop.

D. Pressure Adjustment: Return spring or counter weight with adjustable tension.

E. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Air Balance; MESTEK, Inc.
- b. Aire Technologies, Inc.; DMI Companies
- c. American Warming and Ventilating (AWV); Mestek, Inc.
- d. Arrow United Industries; Mestek, Inc.
- e. Cesco Products; MESTEK, Inc.
- f. Greenheck Fan Corporation
- g. Lloyd Industries, Inc.
- h. McGill AirFlow LLC
- i. Nailor Industries Inc
- j. NCA Manufacturing, Inc.; Metal Industries, Inc.
- k. Pottorff
- l. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
- m. Safe Air - Dowco
- n. United Enertech Corp.
- o. 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 out of airstream.
- b. Suitable for horizontal or vertical airflow applications.

4. Frames:

- a. Hat-shaped.
- 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 or Stainless steel; 16 gauge thick.
 6. Blade Axles: Galvanized steel, Stainless steel, or Nonferrous metal.
 7. Bearings:
 - a. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 8. Tie Bars and Brackets: Galvanized steel.
 9. Locking device to hold damper blades in a fixed position without vibration.
- B. Standard, Aluminum, Manual Volume Dampers for use in aluminum ductwork:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Warming and Ventilating (AWV); Mestek, Inc.
 - b. Arrow United Industries; Mestek, Inc.
 - c. Cesco Products; MESTEK, Inc.
 - d. Linx Industries; a DMI company (formerly Lindab)
 - e. Nailor Industries Inc
 - f. Pottorff
 - g. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - h. Safe Air - Dowco
 - i. United Enertech Corp.
 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 out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 4. Frames:
 - a. Hat-shaped, 0.10-inch- thick, aluminum sheet channels.
 - b. 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. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 6. Blade Axles: Galvanized steel, Stainless steel, or Nonferrous metal.
 7. Bearings:
 - a. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 8. Tie Bars and Brackets: Aluminum.
 9. Locking device to hold damper blades in a fixed position without vibration.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Air Balance; MESTEK, Inc.
 - b. American Warming and Ventilating (AWV); Mestek, Inc.
 - c. Arrow United Industries; Mestek, Inc.
 - d. Cesco Products; MESTEK, Inc.
 - e. Greenheck Fan Corporation
 - f. Nailor Industries Inc
 - g. Pottorff
 - h. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - i. Safe Air - Dowco
 - j. Vent Products Co., Inc
2. Performance:
 - a. AMCA Certification: Test and rate in accordance with AMCA 511.
 - b. Leakage:
 - 1) Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - 2) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - 3) Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Construction:
 - a. Linkage: Out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
4. Frames:
 - a. Hat, U, or angle shaped.
 - b. Thickness: 16-gauge galvanized sheet steel or 18-gauge stainless steel.
 - c. Mitered and welded corners.
 - d. 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 or Stainless, roll-formed steel; 16 gauge thick.
6. Blade Edging Seals:
 - a. Closed-cell neoprene or PVC.
 - b. Inflatable seal blade edging or replaceable rubber seals.
7. Bearings:
 - a. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
8. Tie Bars and Brackets: Galvanized steel or Aluminum.
9. Locking device to hold damper blades in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Air Balance; MESTEK, Inc.
 - b. American Warming and Ventilating (AWV); Mestek, Inc.
 - c. Arrow United Industries; Mestek, Inc.
 - d. Cesco Products; MESTEK, Inc.
 - e. ottorff
 - f. [Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - g. Safe Air - Dowco
 - h. United Enertech Corp.
 - i. Vent Products Co., Inc
2. Performance:
 - a. [AMCA Certification: Test and rate in accordance with AMCA 511.]
 - b. Leakage:
 - 1) Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - 2) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - 3) Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Construction:
 - a. Linkage out of airstream suitable for horizontal or vertical airflow applications.
4. Frames:
 - a. Hat, U, or angle shaped.
 - b. Thickness: 0.08-inch aluminum sheet channels.
 - 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. Roll-Formed Aluminum Blades: 0.072-inch-thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Edging Seals:
 - a. Closed-cell neoprene or PVC.
 - b. Inflatable seal blade edging or replaceable rubber seals.
7. Bearings:
 - a. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.
8. Tie Bars and Brackets: Galvanized steel or Aluminum.
9. Locking device to hold damper blades in a fixed position without vibration.

E. Jackshaft:

1. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each

- mullion and at each end of multiple-damper assemblies.
2. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. American Warming and Ventilating (AWV); Mestek, Inc.]
2. Arrow United Industries; Mestek, Inc.]
3. Carnes Company]
4. Cesco Products; MESTEK, Inc.
5. Greenheck Fan Corporation
6. Lloyd Industries, Inc.
7. McGill AirFlow LLC
8. Metal Form Manufacturing LLC; United Enertech Corp.
9. Nailor Industries Inc
10. NCA Manufacturing, Inc.; Metal Industries, Inc.
11. Pottorff
12. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
13. Safe Air - Dowco
14. United Enertech Corp.
15. Vent Products Co., Inc

B. General Requirements:

1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:
 - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
 - d. Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm.
5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:
 - a. Hat, U, or angle shaped.
 - b. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple-blade with maximum blade width of 8 inches.
5. Blade Edging Seals:
 - a. Replaceable Closed-cell neoprene or PVC.
 - b. Inflatable seal blade edging, or replaceable rubber seals.
6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; galvanized or stainless steel.
8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
9. Bearings:
 - a. [
 - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

E. Damper Actuator - Electric:

1. UL 873, plenum rated.
2. Fully modulating with fail-safe spring return.
 - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Minimum 90-degree drive rotation.
3. Clockwise or counterclockwise drive rotation as required for application.
4. Environmental Operating Range:
 - a. Temperature: Minus 40 to plus 130 deg F.
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
5. Environmental enclosure: NEMA 2.
6. Actuator to be factory mounted and provided with a single-point wiring connection.

F. Damper Actuator - Pneumatic:

1. Operated by 0 to 20 psig pneumatic signal.
2. Fully modulating with positioner and fail-safe spring return.
 - a. Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Maximum 15-second full-stroke closure.
3. Actuator to be factory mounted.

2.6 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Air Balance; MESTEK, Inc.
 2. Aire Technologies, Inc.; DMI Companies
 3. Arrow United Industries; Mestek, Inc.
 4. Cesco Products; MESTEK, Inc.
 5. CL WARD & Family Inc.
 6. Greenheck Fan Corporation
 7. NCA Manufacturing, Inc.; Metal Industries, Inc.
 8. Pottorff
 9. Prefco
 10. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 11. Safe Air - Dowco
 12. United Enertech Corp.
 13. Vent Products Co., Inc
- B. Type: Static and dynamic; rated and labeled in accordance with UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: [Multiple-blade type or Curtain type with blades outside airstream except when there is not sufficient space available; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet or stainless steel; gauge in accordance with UL listing.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed. Material gauge is to be in accordance with UL listing.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device:
1. Replaceable fusible links.

2.7 CEILING RADIATION DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Air Balance; MESTEK, Inc.
 2. Aire Technologies, Inc.; DMI Companies
 3. Arrow United Industries; Mestek, Inc.
 4. Cesco Products; MESTEK, Inc.
 5. CL WARD & Family Inc.
 6. Greenheck Fan Corporation
 7. Lloyd Industries, Inc.
 8. Nailor Industries Inc
 9. NCA Manufacturing, Inc.; Metal Industries, Inc.
 10. Pottorff
 11. Prefco
 12. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

13. Safe Air - Dowco
14. United Enertech Corp.

B. General Requirements:

1. Labeled according to UL 555C by an NRTL.
 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction; gauge in accordance with UL listing.
- D. Blades: Galvanized sheet steel with refractory insulation; gauge in accordance with UL listing.
- E. Heat-Responsive Device: Replaceable fusible links.
- F. Fire Rating: 1, 2, or 3 hour(s).

2.8 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Air Balance; MESTEK, Inc.
2. Aire Technologies, Inc.; DMI Companies
3. Arrow United Industries; Mestek, Inc.
4. Cesco Products; MESTEK, Inc.
5. CL WARD & Family Inc.
6. Greenheck Fan Corporation
7. Pottorff
8. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
9. Safe Air - Dowco
10. United Enertech Corp.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
3. Unless otherwise indicated, use parallel-blade configuration.
4. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.
5. Factory install damper actuator by damper manufacturer as integral part of damper assembly. Coordinate actuator location, mounting, and electrical requirements with damper manufacturer.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.
2. Leakage:
 - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade

deflection of 1/200 of blade length.

D. Construction:

1. Suitable for horizontal or vertical airflow applications.
2. Linkage out of airstream.
3. Frame:
 - a. Hat shaped.
 - b. Gauge in accordance with UL listing.

Vertical blades are available for special applications.

4. Blades:

- a. Maximum width and gauge in accordance with UL listing.

5. Blade Edging Seals:

- a. Silicone rubber.

6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; galvanized steel or stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage is to be mounted out of airstream.

E. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application; gauge in accordance with UL listing.

F. Damper Actuator - Electric:

1. UL 873, plenum rated.
2. Designed to operate in smoke-control systems complying with UL 555S requirements.
3. Two-position or Fully modulating with fail-safe spring return.
 - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Maximum 15-second full-stroke closure.
 - c. Minimum 90-degree drive rotation.
4. Clockwise or counterclockwise drive rotation as required for application.
5. Environmental Operating Range:
 - a. Temperature: Minus 40 to plus 130 deg F.
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
6. Environmental Enclosure: NEMA 2.
7. Actuator to be factory mounted and provided with single-point wiring connection.

G. Damper Actuator - Pneumatic:

1. Operated by 0 to 20 psig pneumatic signal.
2. Designed to operate in smoke-control systems complying with UL 555S requirements.
3. Fail-safe spring return.
 - a. Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Maximum 15-second full-stroke closure.

4. Actuator to be factory mounted.

H. Accessories:

1. Auxiliary switches for signaling, fan control, or position indication.
2. Test and reset switches.
3. Smoke Detector: Integral, factory wired for single-point connection.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Air Balance; MESTEK, Inc.
2. Aire Technologies, Inc.; DMI Companies
3. Arrow United Industries; Mestek, Inc.
4. Cesco Products; MESTEK, Inc.
5. CL WARD & Family Inc.
6. Greenheck Fan Corporation
7. NCA Manufacturing, Inc.; Metal Industries, Inc.
8. Pottorff
9. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
10. Safe Air - Dowco
11. United Enertech Corp.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
3. Unless otherwise indicated, use parallel-blade configuration.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Performance:

1. AMCA Certification: Test and rate in accordance with AMCE Publication 511.
2. Leakage:
 - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Pressure Drop: 0.05 in. wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm.
5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

F. Construction:

1. Suitable for horizontal or vertical airflow applications.
2. Linkage out of airstream.
3. Frame:

- a. Hat shaped.
 - b. Gauge is to be in accordance with UL listing.
- 4. Blades:
 - a. Maximum width and gauge in accordance with UL listing.
- 5. Blade Edging Seals:
 - a. Silicone rubber.
- 6. Blade Jamb Seal: Flexible stainless steel, compression type.
- 7. Blade Axles: 1/2-inch- diameter; galvanized steel or stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of airstream.
- G. Mounting Sleeve:
 - 1. Factory installed galvanized sheet steel.
 - 2. Length to suit wall or floor application.
 - 3. Gauge in accordance with UL listing.
- H. Heat-Responsive Device:
 - 1. Resettable or Replaceable fusible links or fire-closure device.
 - 2. Electric resettable link or device and switch package, factory installed, rated.
- I. Master control panel for use in dynamic smoke-management systems.
- J. Damper Actuator - Electric:
 - 1. UL 873, plenum rated.
 - 2. Designed to operate in smoke-control systems complying with UL 555S requirements.
 - 3. Two position or Fully modulating with fail-safe spring return.
 - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Maximum 15-second full-stroke closure.
 - c. Minimum 90-degree drive rotation.
 - 4. Clockwise or counterclockwise drive rotation as required for application.
 - 5. Environmental Operating Range:
 - a. Temperature: Minus 40 to plus 130 deg F.
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
 - 6. Environmental Enclosure: NEMA 2.
 - 7. Actuator to be factory mounted and provided with single-point wiring connection.
- K. Accessories:
 - 1. Auxiliary switches for signaling, fan control, or position indication.
 - 2. Momentary test switch or Test and reset switches.
 - 3. Smoke Detector: Integral, factory wired for single-point connection.

2.10 CORRIDOR DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Aire Technologies, Inc.; DMI Companies
2. Cesco Products; MESTEK, Inc.
3. Pottorff
4. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
5. Safe Air - Dowco
6. United Enertech Corp.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 90A 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, 1-1/2, and 2 hours.

E. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.
2. Leakage:
 - a. Class 1A: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - b. Class 1: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

F. Construction:

1. Frame: Hat shaped, galvanized sheet steel, gauge in accordance with UL listing.

Vertical blades are available for special applications.

2. Blades: Roll-formed, horizontal, interlocking or overlapping, galvanized sheet steel; gauge in accordance with UL listing.

G. Mounting Sleeve:

1. Factory installed, galvanized sheet steel.
2. Length to suit wall or floor application.
3. Gauge in accordance with UL listing.

H. Heat-Responsive Device:

1. Resettable or Replaceable rated, fusible links or fire-closure device.
2. Electric resettable link or device and switch package, factory installed, rated.

I. Damper Actuator - Electric:

1. UL 873, plenum rated.
2. Designed to operate in smoke-control systems complying with UL 555S requirements.
3. Two position with fail-safe spring return.
 - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Maximum 15-second full-stroke closure.
 - c. Minimum 90-degree drive rotation.

4. Clockwise or counterclockwise drive rotation as required for application.
5. Environmental Operating Range:
 - a. Temperature: Minus 40 to plus 130 deg F.
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
6. Environmental enclosure: NEMA 2.
7. Actuator to be factory mounted and provided with single-point wiring connection.

J. Accessories:

1. Auxiliary switches for signaling, fan control, or position indication.
2. Momentary test switch or Test and reset switches.
3. Smoke Detector: Integral, factory wired for single-point connection.

2.11 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company
 3. DynAir; a Carlisle Company
 4. Elgen Manufacturing
 5. Ward Industries; a brand of Hart & Cooley, LLC
- B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

2.12 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. FläktGroup
 2. Flexmaster U.S.A., Inc
 3. IAC Acoustics
 4. McGill AirFlow LLC
 5. Metal Form Manufacturing LLC; United Enertech Corp.
 6. Pottorff
 7. Price Industries Limited]
 8. Ruskin; Air Distribution Technologies, Inc.; Jonson Controls, Inc.
 9. Vibro-Acoustics
- B. General Requirements:
1. Factory fabricated.
 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 4. Bearing AMCA's Certified Ratings Seal for prefabricated silencer sound and air performance.

- C. Shape:
1. Rectangular straight with splitters or baffles.
 2. Round straight with center bodies or pods.
 3. Rectangular elbow with splitters or baffles.
 4. Round elbow with center bodies or pods.
 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A653/A653M, galvanized sheet steel.
- E. Round Silencer Outer Casing: ASTM A653/A653M, galvanized sheet steel.
1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 22 gauge thick.
 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 20 gauge thick.
 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 18 gauge thick.
 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 16 gauge thick.
- F. Inner Casing and Baffles: ASTM A653/A653M, galvanized sheet metal, 22 gauge thick, and with 1/8-inch-diameter perforations.
- G. Special Construction:
1. Suitable for outdoor use.
 2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 2. Dissipative or Film-lined type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression.
 - b. Erosion Barrier: Polymer bag enclosing fill, heat-sealed before assembly.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Joints: Lock formed and sealed, Continuously welded, or flanged connections.
 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.
 2. Removable splitters.
 3. Airflow-measuring devices.
- L. Source Quality Control:
1. Test in accordance with ASTM E477.
 2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000 fpm face velocity.
 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.13 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Aero-Dyne Sound Control Co.
 2. CL WARD & Family Inc.
 3. Ductmate Industries, Inc; a DMI company
 4. Duro Dyne Inc.
 5. DynAir; a Carlisle Company
 6. Elgen Manufacturing
 7. Ward Industries; a brand of Hart & Cooley, LLC
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- E. Vane Construction:
1. Single wall for ducts up to 48 inches > wide and double wall for larger dimensions.

2.14 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. DynAir; a Carlisle Company
 2. METALAIRE, Inc
 3. United Enertech Corp.
 4. Young Regulator Company
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass, Copper, or Aluminum.
- D. Cable: Stainless steel.

2.15 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Aire Technologies, Inc.; DMI Companies
 2. Arrow United Industries; Mestek, Inc.
 3. [Cesco Products; MESTEK, Inc.
 4. CL WARD & Family Inc.
 5. Ductmate Industries, Inc; a DMI company
 6. Duro Dyne Inc.

7. Elgen Manufacturing
8. Flexmaster U.S.A., Inc
9. McGill AirFlow LLC
10. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
11. United Enertech Corp.
12. Ventfabrics, Inc
13. Ward Industries; a brand of Hart & Cooley, LLC

- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 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. 24-gauge- thick galvanized steel, 0.032-inch-thick aluminum, or 24-gauge- thick stainless steel door panel.
 - d. Vision panel.
 - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - f. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - a. 24-gauge- thick galvanized steel or 0.032-inch- thick aluminum frame.

- C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
 - a. 24-gauge- thick galvanized steel, 0.032-inch- thick aluminum, or 24-gauge- thick stainless steel door panel.
2. Door: Single wall or 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. Doors close when pressures are within set-point range.
5. Hinge: Continuous piano.
6. Latches: Cam.
7. Seal: Neoprene or foam rubber.
8. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.16 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company
3. Flame Gard, Inc

- B. Access panels used in cooking applications:

1. Labeled compliant to NFPA 96 for grease duct access doors.
2. Labeled in accordance with UL 1978 by an NRTL.

- C. Panel and Frame: Minimum thickness 16-gauge carbon or 16-gauge stainless steel.

- D. Fasteners: Carbon or Stainless steel to match panel and frame. 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 inches wg positive or negative.

2.17 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc; a DMI company
 - 3. Duro Dyne Inc.
 - 4. DynAir; a Carlisle Company
 - 5. Elgen Manufacturing
 - 6. Ventfabrics, Inc
 - 7. Ward Industries; a brand of Hart & Cooley, LLC
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- G. 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.
- H. 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.
- I. 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.
- J. 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.

K. 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. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.18 DUCT SECURITY BARS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Carnes Company
2. Kees, Inc
3. Lloyd Industries, Inc.
4. Metal Form Manufacturing LLC; United Enertech Corp.
5. Price Industries Limited
6. United Enertech Corp.

B. Description: Field- or factory-fabricated and field-installed duct security bars.

C. Configuration:

1. Angle frame of 2-1/2 by 2-1/2 by 1/4 inch.
2. Sleeve: 3/16-inch, continuously welded steel frames with 1-1/2-by-1-1/2-by-1/8-inch angle frame . To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
3. Horizontal Bars: 2 by 1/4 inch.
4. Vertical Bars: 2 by 1/4 inch.
5. Bar Spacing: 6 inches.

2.19 DUCT ACCESSORY HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company
3. Duro Dyne Inc.
4. DynAir; a Carlisle Company
5. Elgen Manufacturing
6. Hardcast; Carlisle Construction Materials
7. United Enertech Corp.
8. Ventfabrics, Inc
9. Ward Industries; a brand of Hart & Cooley, LLC

B. 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.

- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.20 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221, 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- 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.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- G. Install fire and smoke dampers in accordance with UL listing.
- H. Duct security bars:
 - 1. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints, and 1/2-

- inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to four sides and both ends of sleeve.
 2. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
 3. Secure duct security bar assembly to building structure as indicated in manufacturer's installation instructions.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
 2. Upstream from duct filters.
 3. At outdoor-air intakes and mixed-air plenums.
 4. At drain pans and seals.
 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. For grease ducts, install at locations and spacing as required by NFPA 96.
 8. Control devices requiring inspection.
 9. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. 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.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Install duct test holes where required for testing and balancing purposes.
- O. 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 size and location of access doors are adequate to perform required operation.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Flexible ducts, noninsulated.
 2. Flexible ducts, insulated.
 3. Flexible duct connectors.

1.2 ACTION SUBMITTALS

- A. Product Data:
1. Flexible ducts, noninsulated.
 2. Flexible ducts, insulated.
 3. Flexible duct connectors.
- B. Product Data Submittals: For each type of product.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."
- D. Comply with ASTM E96/E96M.

2.2 FLEXIBLE DUCTS, NONINSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Noninsulated - Class 1, Two-Ply Vinyl or Polyethylene Film Supported by Helically Wound, Spring-Steel Wire:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Flexmaster U.S.A., Inc
 - b. JP Lamborn Co.

- c. Thermaflex; a Flex-Tek Group company
- 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 10 to plus 160 deg F.
- C. Flexible Ducts, Noninsulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Flexmaster U.S.A., Inc
 - 2. Pressure Rating: 4 inch wg positive and 0.5 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 20 to plus 175 deg F.
- D. Flexible Ducts, Noninsulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Flexmaster U.S.A., Inc
 - 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 20 to plus 210 deg F.
- E. Flexible Ducts, Noninsulated - Class 1, Aluminum Laminate and Polyester Film with Latex Adhesive Supported by Helically Wound, Spring-Steel Wire:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Flexmaster U.S.A., Inc
 - 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 20 to plus 210 deg F.
- F. Flexible Ducts, Noninsulated - Class 0, Interlocking Spiral of Aluminum Foil:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ATCO Rubber Products, Inc.
 - b. Flexmaster U.S.A., Inc
 - 2. Pressure Rating: 8 inch wg positive or negative.
 - 3. Maximum Air Velocity: 5000 fpm.
 - 4. Temperature Range: Minus 100 to plus 435 deg F.

2.3 FLEXIBLE DUCTS, INSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ATCO Rubber Products, Inc.
 - b. Flexmaster U.S.A., Inc
 - c. JP Lamborn Co.
 - d. Thermaflex; a Flex-Tek Group company
 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 3. Maximum Air Velocity: 4000 fpm.
 4. Temperature Range: Minus 10 to plus 160 deg F.
 5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
 6. Vapor-Barrier Film: Polyethylene or Aluminized.
- C. Flexible Ducts, Insulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. CASCO C.A. Schroeder, Inc.
 - b. Flexmaster U.S.A., Inc
 - c. JP Lamborn Co.
 - d. Thermaflex; a Flex-Tek Group company
 2. Pressure Rating: 4 inch wg positive and 0.5 inch wg negative.
 3. Maximum Air Velocity: 4000 fpm.
 4. Temperature Range: Minus 20 to plus 175 deg F.
 5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
 6. Vapor-Barrier Film: Polyethylene or Aluminized.
- D. Flexible Ducts, Insulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Flexmaster U.S.A., Inc
 - b. JP Lamborn Co.
 - c. Thermaflex; a Flex-Tek Group company
 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 3. Maximum Air Velocity: 4000 fpm.
 4. Temperature Range: Minus 20 to plus 210 deg F.
 5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
 6. Vapor-Barrier Film: Polyethylene or Aluminized.
- E. Flexible Ducts, Insulated - Class 1, Aluminum Laminate and Polyester Film with Latex Adhesive Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Flexmaster U.S.A., Inc
 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 3. Maximum Air Velocity: 4000 fpm.
 4. Temperature Range: Minus 20 to plus 210 deg F.
 5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
 6. Vapor-Barrier Film: Polyethylene or Aluminized.
- F. Flexible Ducts, Insulated - Class 0, Interlocking Spiral of Aluminum Foil; Fibrous-Glass Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Flexmaster U.S.A., Inc
 - b.
2. Pressure Rating: 8 inch wg positive or negative.
3. Maximum Air Velocity: 5000 fpm.
4. Temperature Range: Minus 20 to plus 250 deg F.
5. Insulation R-Value: Comply with ASHRAE/IES 90.1 .
6. Vapor-Barrier Film: [Polyethylene] [Aluminized].

2.4 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless steel band with stainless steel or zinc-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Adhesive, Liquid adhesive plus tape, or Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF FLEXIBLE DUCTS

- A. Install flexible ducts in accordance with applicable details in the following publications:
 1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
 2. NAIMA AH116.
 3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
 4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.
- C. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers and light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with adhesive, liquid adhesive plus tape, draw bands, or adhesive plus sheet metal screws.
- F. Installation:
 1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
 6. Install in accordance with ADC instructions.
- G. Supporting Flexible Ducts:
 1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft.. Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. between supports. A connection to rigid duct or equipment may be considered a support joint.

2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.
4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 23 33 46

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Axial roof ventilators.
2. Ceiling-mounted ventilators.
3. Centrifugal ventilators - roof downblast.
4. Centrifugal ventilators - roof upblast and sidewall.
5. Sidewall propeller fans.
6. Upblast propeller roof exhaust fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

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 unit 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/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.2 ALL HVAC POWER VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Acme Engineering & Manufacturing Corp.
 - 2. Aerovent; a division of Twin City Fan Companies, Ltd.
 - 3. Airmaster Fan; a brand of MAICO
 - 4. American Coolair Corporation
 - 5. Broan.; a Broan-NuTone LLC brand; a Nortek company
 - 6. FloAire National
 - 7. Greenheck Fan Corporation
 - 8. Hartzell Fan Incorporated
 - 9. JencoFan
 - 10. Loren Cook Company
 - 11. Moffitt Corporation
 - 12. New York Blower Company (The)
 - 13. PennBarry; division of Air System Components
 - 14. Quietaire Inc.
 - 15. Rupp Air Management Systems
 - 16. S & P USA Ventilation Systems, LLC
 - 17. Refer to the Fans Schedules in the construction drawings for performance requirements, sizes, material construction requirements, and accessories.

2.3 SOURCE QUALITY CONTROL

- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
- C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.
- D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
 - 1. Secure roof-mounted fans to roof curbs with zinc-plated hardware.
 - 2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Install units with clearances for service and maintenance.

3.2 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

3.3 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 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."

3.5 STARTUP SERVICE:

- A. Perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.
 - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
 - 6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 7. Adjust 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. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 12. Shut unit down and reconnect automatic temperature-control operators.
 - 13. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties.
 - 3. Fans and components will be considered defective if they do not pass tests and inspections.
 - 4. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 23 37 13.13

AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Perforated diffusers.
4. Louver face diffusers.
5. Linear bar diffusers.
6. Linear slot diffusers.
7. Ceiling-integral continuous slot diffusers.
8. Light troffer diffusers.
9. Round induction underfloor air-distribution diffusers.
10. Linear underfloor air-distribution diffuser plenums.
11. High-capacity drum louver diffusers.
12. High-capacity, modular-core supply grille diffusers.

1.2 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.

PART 2 - PRODUCTS

2.1 ALL CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
2. Carnes Company
3. Hart & Cooley, LLC
4. Krueger-HVAC; brand of Johnson Controls International plc, Global Products
5. METALAIRE, Inc
6. Nailor Industries Inc
7. Price Industries Limited
8. Shoemaker Mfg. Co.
9. Titus; brand of Johnson Controls International plc, Global Products
10. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products

B. Refer to the Air Devices Schedules in the construction drawings for performance requirements, sizes, material construction requirements, and accessories.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers 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 diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 37 13.23

REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adjustable blade face registers and grilles.
2. Fixed face registers and grilles.
3. Linear bar grilles.

1.2 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. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 ALL REGISTERS AND GRILLES

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

- a. A-J Manufacturing Co., Inc
 - b. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
 - c. Carnes Company
 - d. Dayus Register & Grille Inc.
 - e. Hart & Cooley, LLC
 - f. Kees, Inc
 - g. Krueger-HVAC; brand of Johnson Controls International plc, Global Products
 - h. METALAIRE, Inc
 - i. Nailor Industries Inc
 - j. Price Industries Limited
 - k. Raymon Company
 - l. Shoemaker Mfg. Co.
 - m. Titus; brand of Johnson Controls International plc, Global Products
 - n. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products
2. Refer to the Air Devices Schedules in the construction drawings for performance requirements, sizes, material construction requirements, and accessories.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where registers and grilles 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 registers and grilles level and plumb.
- B. Outlets and Inlets Locations: 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 registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 82 39.19

WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Wall and ceiling unit heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

PART 2 - PRODUCTS

2.1 WALL AND CEILING UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Berko; Marley Engineered Products
 2. Chromalox, Inc.
 3. Glen Dimplex Americas
 4. INDEECO
 5. Markel Products Company; a subsidiary of TPI Corporation
 6. Marley Engineered Products
 7. Ouellet Canada Inc
 8. QMark; Marley Engineered Products
 9. Trane
- B. Heaters: Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- 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.

2.2 CABINET

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.3 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless steel, machine-staked terminals secured with stainless steel hardware, and limit controls for high-temperature protection.

2.4 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230500 "Common Work Results for HVAC."

2.5 CONTROLS

- A. Controls: Unit-mounted thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WALL AND CEILING UNIT HEATERS

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

END OF SECTION

SECTION 26 00 10

SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
 - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.
 - c. Elevators.
 - d. Fire-alarm systems.

1.3 FIELD CONDITIONS

- A. Service Conditions for Electrical Power Equipment: Electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1. Copper building wire.
2. Aluminum building wire.
3. Connectors and splices.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Conductor Insulation:
 1. Type NM. Comply with UL 83 and UL 719.
 2. Type THHN, and Type THWN-2. Comply with UL 83.

2.2 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.
- D. Conductor Insulation:
 1. Type NM. Comply with UL 83 and UL 719.
 2. Type THHN, and Type THWN-2. Comply with UL 83.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing

agency, and marked for intended location and use.

- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 - 1. Copper:
 - a. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway. If allowed by authorities having jurisdiction, Nonmetallic-sheathed cable, Type NM.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- H. 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, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not

damage cables or raceway.

- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.6 FIELD QUALITY CONTROL

- A. 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 of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect cable jacket and condition.

END OF SECTION

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backboards.
 - 2. Category 5e balanced twisted pair cable.
 - 3. Control-circuit conductors.

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. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: **60 inch** or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, **3/4 by 48 by 96 inch** or size as per Owner.

2.3 CATEGORY 5e BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- C. Conductors: 100 ohm, No. 24 AWG solid copper.
 - 1. Lead Content: Less than 300 parts per million.
- D. Shielding/Screening: Shielded twisted pairs (FTP).

- E. Cable Rating: Plenum.
- F. Jacket: Gray thermoplastic or as coordinated with building owner.

2.4 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- B. Class 2 Control Circuits: Stranded copper, power-limited cable, concealed in building finishes.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, power-limited cable, concealed in building finishes.
- D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
 - 1. Smoke control signaling and control circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- B. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering the room from overhead.
 - 4. Extend conduits 3 inch above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- C. Backboards: Install backboards with **96 inch** dimension vertical or as directed by Owner. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."

3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 6. Secure and support cables at intervals not exceeding **30 inch** and not more than **6 inch** from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 11. Support: Do not allow cables to lie on removable ceiling tiles.
 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 13. Provide strain relief.
 14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 15. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.
- C. Installation of Control-Circuit Conductors:
1. Install wiring in raceways.
 2. Use insulated spade lugs for wire and cable connection to screw terminals.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of **8 inch** above ceilings by cable supports not more than 30 inch apart.
 3. Cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
- E. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of **5 inch**.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of **12 inch**.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of **24 inch**.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of **2-1/2 inch**.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of **6 inch**.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of **12 inch**.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of **3 inch**.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of **6 inch**.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of **48 inch**.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.5 FIRESTOPPING

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper, or, tinned-copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Isolated Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper, or, tinned-copper wire or cable, green color with one or more yellow stripes, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3.
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
 - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.

B. Performance Criteria:

1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

C. UL KDER - Beam Grounding and Bonding Clamp:

1. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

D. UL KDER - Exothermically Welded Connection:

1. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.4 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.5 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding devices that serve as common connection for multiple grounding and bonding conductors.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and

application.

2. Listing Criteria:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.6 GROUNDING (EARTHING) ELECTRODES

A. Performance Criteria:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

B. UL KDER - Rod Electrode:

- 1. General Characteristics: Copper-clad steel, sectional type; 5/8 inch by 8 ft.

PART 3 - EXECUTION

3.1 SELECTION OF GROUNDING AND BONDING PRODUCTS

A. Grounding and Bonding Conductors:

- 1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
- 2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
- 3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, **1/4 inch** in diameter.
- 4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
- 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; **1-5/8 inch** wide and **1/16 inch** thick.
- 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; **1-5/8 inch** wide and **1/16 inch** thick.
- 7. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum.

B. Grounding and Bonding Connectors:

- 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
- 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
- 3. Connections to Ground Rods at Test Wells: Bolted connectors.
- 4. Connections to Structural Steel: Welded connectors.

3.2 INSTALLATION OF GROUNDING AND BONDING

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Grounding and Bonding Conductors:
 - a. Underground Grounding Conductors:
 - 1) Bury at least **30 inch** below grade.
2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. 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 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 disconnect-type connection is required, use bolted clamp.
 - g. 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 bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where 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 bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 ft** apart.
3. Electrodes:
 - a. Ground Rods: Drive rods until tops are **2 inch** below finished floor or final grade unless otherwise indicated.
 - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2) Use exothermic welds for below-grade connections.
4. Grounding at Service:
 - a. Equipment grounding conductors and grounding electrode conductors must be connected to

ground busbar. Install main bonding jumper between neutral and ground buses.

5. Equipment Grounding and Bonding:

- a. 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.
- b. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- c. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
- d. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
- e. Poles Supporting Outdoor Lighting Fixtures: Bond insulated equipment grounding conductor to equipment grounding terminal inside pole base.

3.3 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by 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 in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 3. Channel Width: Selected for applicable load criteria.
 - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must 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.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA NEIS 101
 2. NECA NEIS 105.
 3. NECA NEIS 111.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.
- C. 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 single-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 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT, IMC, and, ERMC may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
 6. To Steel: 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 seismic-restraint strength and anchorage requirements.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 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.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup:
 - 1. 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.
 - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 05 33.13

CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE EMT DUCT RACEWAYS AND ELBOWS

- A. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FJMX; including UL 797.
 - 2. Standard Features:
 - a. Material: Steel.
 - b. Exterior Coating: Zinc.
 - c. Interior Coating: Zinc with organic top coating.
 - d. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.3 TYPE FMC DUCT RACEWAYS

- A. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DXUZ; including UL 1.
 - 2. Standard Features:
 - a. Material: Steel.
 - b. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.4 TYPE IMC DUCT RACEWAYS

- A. UL DYBY - Steel Intermediate Metal Conduit (IMC):
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

- a. UL CCN DYBY; including UL 1242.

2. Standard Features:

- a. Exterior Coating: Zinc.
- b. Interior Coating: Zinc with organic top coating.
- c. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.5 TYPE LFMC DUCT RACEWAYS

A. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):

- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DXHR; including UL 360.
- 2. Standard Features:
 - a. Material: Steel.
 - b. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.6 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DZYR; including UL 651.
- 2. Standard Features:
 - a. Dimensional Specifications: Schedule 40.
 - b. Minimum Trade Size: Metric designator 16 (trade size 1/2).
 - c. Markings: For use with maximum 90 deg C wire.

2.7 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. UL DWTT - Fittings for Type ERM C, Type IMC, Type PVC, Type HDPE, Type EPEC, and Type RTRC Duct Raceways:

- a.
- 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DWTT; including UL 514B.
- 3. Standard Features:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

B. UL FKA V - Fittings for Type EMT Duct Raceways:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FKA V; including UL 514B.
2. Standard Features:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

C. UL ILNR - Fittings for Type FMC Duct Raceways:

- a.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN ILNR; including UL 514B.

D. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DXAS; including UL 514B.

2.8 SOLVENT CEMENTS

A. UL VBEW - Solvent Cements for Nonmetallic Duct Raceways and Fittings:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Solvent Cements: UL CCN VBEW; including UL 340.
 - b. Solvent Cement Compatibility with PVC Conduit Fittings: UL CCN DWTT; including UL 514B. Follow solvent manufacturer's published instructions.
 - c. Solvent Cement Compatibility with Rigid PVC Conduit: UL CCN DZYR; including UL 651. Follow solvent manufacturer's published instructions.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturer's published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 1. Exposed and Subject to Severe Physical Damage: IMC.
 2. Exposed and Subject to Physical Damage: Corrosion-resistant EMT.

3. Exposed and Not Subject to Physical Damage: Corrosion-resistant EMT.
4. Concealed Aboveground: EMT.
5. Direct Buried: PVC-40.
6. Concrete Encased Not in Trench: PVC-40.
7. Concrete Encased in Trench: PVC-40.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Hazardous Classified Locations: IMC.
2. Exposed and Subject to Severe Physical Damage: IMC.
3. Exposed and Subject to Physical Damage: EMT.
4. Exposed and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Damp or Wet Locations: IMC.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC; Subject to wet or damp locations, use LFMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMIC and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Safety: NFPA 70E.
3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
5. Communications Work: BICSI N1.
6. Life Safety and Means of Egress Work: NFPA 101.
7. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
8. Work in Confined Spaces: NFPA 350.
9. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
10. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
11. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
12. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
13. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
14. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
15. Expansion Fittings: NEMA FB 2.40.
16. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:
 - a. Complete duct raceway installation before starting conductor installation.
 - b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of **2 ft** above finished floor.
 - c. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within **12 inch** of changes in direction.

- d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 - e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - f. Support conduit within **12 inch** of enclosures to which attached.
 - g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
 - h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct 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 duct raceway enters a building or structure.
 - 3) Conduit extending from interior to exterior of building.
 - 4) Conduit extending into pressurized duct raceway and equipment.
 - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6) Where otherwise required by NFPA 70.
 - i. Do not install conduits within **2 inch** of the bottom side of a metal deck roof.
 - j. Keep duct raceways at least **6 inch** away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - k. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - l. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than **200 lb** tensile strength. Leave at least **12 inch** of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
 - m. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - n. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
2. Types ERM and IMC:
- a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
3. Types FMC, LFMC, and LFNC:
- a. Provide a maximum of 36 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
4. Types PVC, HDPE, and EPEC:
- a. Do not install Type PVC, Type HDPE, or Type EPEC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.

- b. Comply with manufacturer's published instructions for solvent welding and fittings.
 - c. Join joints with solvent cement in accordance with manufacturer's published instructions and allowed to cure before handling. Joints to be bent, pushed, or pulled must set for minimum 24 h after joining.
 - 5. Duct Raceways Embedded in Slabs:
 - a. Run duct raceways parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place duct raceway close to slab support. Secure duct raceways to reinforcement at maximum 10 ft intervals.
 - b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 - c. Arrange duct raceways to ensure that each is surrounded by minimum of 1 inch of concrete without voids.
 - d. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
 - 6. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT, IMC, or ERM for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 - 7. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - a. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
 - b. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
 - 8. Expansion-Joint Fittings:
 - a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed **30 deg F** and that have straight-run length that exceeds **25 ft**. Install in runs of aboveground ERM and EMT conduit that are located where environmental temperature change may exceed **100 deg F** and that have straight-run length that exceeds **100 ft**.
 - b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - 1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - 2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - 3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - 4) Attics: 135 deg F temperature change.
 - c. 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.
 - d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 - e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
 - 9. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
- D. Interfaces with Other Work:

1. Firestop penetrations of fire-rated floor and wall assemblies.
2. Provide conduit hangers and supports.

3.3 FIELD QUALITY CONTROL OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Conduit Placement:
 - a. Verify that nuts on bolts or hanger rods are secure.
 - b. Verify that space between raceways and cored holes are filled with non-shrinking grout or other approved material indicated on the Drawings and the Specifications.
 - c. Verify that expansion devices are installed at locations indicated on the Drawings and the Specifications.
 - d. Verify that ends are cut square to provide flush-butting surfaces when spliced and inside edges are free of burrs that could impede installation of cables.
 - e. Verify minimum separation of utilities, or that approved mechanical protection has been provided to surrounding conduit(s) where minimum separation cannot be achieved.

B. Nonconforming Work:

1. Conduit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 33.16

BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. UL QCIT - Metallic Outlet Boxes and Covers:

- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
- 2. Standard Features:
 - a. Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel.
 - c. Sheet Metal Depth: Minimum 1.5 inch.
- 3. Other Available Features Required by the Project:
 - a. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
 - b. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to **70 lb.**

B. UL QCIT - Metallic Conduit Bodies:

- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
- 2. Standard Features: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

C. UL QCIT - Metallic Device Boxes:

- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

- a. UL CCN QCIT; including UL 514A.
- 2. Standard Features:
 - a. Box with provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel.
 - c. Sheet Metal Depth: minimum 1.5 inch.
- D. UL QCIT - Metallic Extension Rings:
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 2. Standard Features: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
- E. UL QCIT - Metallic Floor Boxes and Floor Box Covers:
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 2. Standard Features: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
- F. UL QCIT - Metallic Raised-Floor Boxes and Floor Box Covers:
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 2. Standard Features: Box mounted in raised-floor with floor box cover and other components to complete floor box enclosure.
- G. UL QCIT - Metallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 2. Standard Features: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.
- H. UL QCIT - Metallic Concrete Boxes and Covers:
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 2. Standard Features: Box intended for use in poured concrete.

2.3 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. UL QCMZ - Nonmetallic Outlet Boxes and Covers:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
2. Standard Features: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

B. UL QCMZ - Nonmetallic Conduit Bodies:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
2. Standard Features: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

C. UL QCMZ - Nonmetallic Device Boxes:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
2. Standard Features: Box with provisions for mounting wiring device directly to box.

D. UL QCMZ - Nonmetallic Extension Rings:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
2. Standard Features: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

E. UL QCMZ - Nonmetallic Floor Boxes and Floor Box Covers:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
2. Standard Features: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

F. UL QCMZ - Nonmetallic Raised-Floor Boxes and Floor Box Covers:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in

accordance with guide information and standards specified for the following UL product categories:

- a. UL CCN QCMZ; including UL 514C.
 2. Standard Features: Box mounted in raised-floor with floor box cover and other components to complete floor box enclosure.
- G. UL QCMZ - Nonmetallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
 2. Standard Features: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.
- H. UL QCMZ - Nonmetallic Floor Nozzles:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
 2. Standard Features: Enclosure intended primarily as housing for receptacle, provided with means, such as collar, for surface-mounting on floor, which may or may not include stem to support it above floor level, and is sealed against the entrance of scrub water at floor level.
- I. UL QCMZ - Nonmetallic Concrete Boxes and Covers:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
 2. Standard Features: Box intended for use in poured concrete.
- 2.4 JUNCTION BOXES AND PULL BOXES
- A. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN BGUZ; including UL 50 and UL 50E.
 2. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 - b. Degree of Protection: Type 1.
- B. UL BGUZ - Indoor Cast-Metal Junction and Pull Boxes:
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

- a. UL CCN BGUZ; including UL 50 and UL 50E.
 - 2. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 - b. Degree of Protection: Type 1.
- C. UL BGUZ - Outdoor Polymeric Junction and Pull Boxes:
- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN BGUZ; including UL 50 and UL 50E.
 - 2. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 - b. Degree of Protection: Type 3R.
- 2.5 COVER PLATES FOR DEVICE BOXES
- A. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:
- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
 - 2. Standard Features:
 - a. Cover plate-Securing Screws: Metal with head color to match cover plate finish.
 - b. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - c. Cover Plate Material: As indicated on architectural Drawings.
- B. UL QCIT or QCMZ - Nonmetallic Cover Plates for Device Boxes:
- 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
 - 2. Standard Features:
 - a. Cover Plate-Securing Screws: Metal with head color to match cover plate finish.
 - b. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - c. Cover Plate Material: As indicated on architectural Drawings.
 - d. Color: As indicated on architectural Drawings.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
 - c. Locations Subject to Potential Flooding: Type 6P.
 - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
 - f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
 - 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 12.
 - c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
 - f. Locations Exposed to Hosedown: Type 4.
 - g. Locations Exposed to Brief Submersion: Type 6.
 - h. Locations Exposed to Prolonged Submersion: Type 6P.
 - i. Locations Exposed to Corrosive Agents: Type 4X.
 - j. Locations Exposed to Spraying Oil or Coolants: Type 13.
- C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
 - 1. Boxes with knockouts or unprotected openings are prohibited.
 - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Safety: NFPA 70E.
 - 3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
 - 4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 - 5. Communications Work: BICSI N1.
 - 6. Life Safety and Means of Egress Work: NFPA 101.
 - 7. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
 - 8. Work in Confined Spaces: NFPA 350.
 - 9. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 - 10. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
 - 11. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. 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.
3. 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, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - b. Provide gaskets for cover plates and covers.

3.3 FIELD QUALITY CONTROL OF BOXES AND COVERS

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.

B. Nonconforming Work:

1. Boxes and covers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

3.4 CLEANING

- A. Remove construction dust and debris from boxes before installing cover plates, covers, and hoods.

3.5 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

- A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
 - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Contact Configuration: As required for circuit to be controlled.
 - 3. Contact Rating: As required for circuit to be controlled.
 - 4. Programs:
 - a. Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
 - 6. Astronomic Time: All channels.
 - 7. Automatic daylight savings time changeover.
 - 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

- A. Description: Solid state, with SPST, or DPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
 - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 3. Time Delay: Fifteen-second minimum, to prevent false operation.
 - 4. Surge Protection: Metal-oxide varistor.
 - 5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
 - 6. Failure Mode: Luminaire stays ON.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
 - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.

4. Switch Rating: Not less than 800 VA LED load at 120 V, 1200 VA LED load at 277 V, and 800 W incandescent.
5. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
6. Sensing Technology: PIR.
7. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
8. Capable of controlling load in three-way application.
9. Voltage: Match the circuit voltage.
10. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
11. Color: As indicated by Architect.
12. Faceplate: Color matched to switch.

2.4 LIGHTING CONTACTORS

- A. Description: Electrically operated and mechanically, or electrically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.5 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. 18 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 INSTALLATION OF SENSORS

- 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.

3.2 INSTALLATION OF CONTACTORS

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.
5. Disconnecting and overcurrent protective devices.
6. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
7. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush, and, Surface-mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: UL 50E, Type 1.
 - b. Outdoor Locations: UL 50E, Type 3R.
 2. Height: **7 ft** maximum.
 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
 4. Finishes:
 - a. Panels and Trim: Steel, and, galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
- E. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

F. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum, or Hard-drawn copper, 98 percent conductivity.
 - a. Plating must run entire length of bus.
 - b. Bus must be fully rated for entire length.
2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.

G. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

H. Panelboard Short-Circuit Current Rating:

1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.
 - a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
 - b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2.2 POWER PANELBOARDS

- A. Listing Criteria: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inch high, provide two latches, keyed alike.
- C. Mains: Circuit breaker, or Lugs only as shown on plans.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LOAD CENTERS

- A. Listing Criteria: Comply with UL 67.
- B. Mains: Circuit breaker or lugs only as shown on plans.

- C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.
- E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
 - 5. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
 - 6. Subfeed Circuit Breakers: Vertically mounted.
 - 7. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. Lugs: Compression, or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Mount panelboard cabinet plumb and rigid without distortion of box.
 - 2. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
 - 3. Install overcurrent protective devices and controllers not already factory installed.
 - a. Set field-adjustable, circuit-breaker trip ranges.
 - b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
 - 4. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
 - 5. Install filler plates in unused spaces.
- C. Interfaces with Other Work:
 - 1. 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.

3.3 IDENTIFICATION

- A. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
- C. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
- D. Circuit Directory:
 - 1. Provide directory card inside panelboard door, mounted in transparent card holder.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Nonconforming Work:
 - 1. Panelboards will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

- A. Toggle Switch:

- 1. Listing Criteria: UL CCN WMUZ and UL 20.
- 2. Standard Features:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration:
 - 1) General-duty, 120-277 V, 20 A.

- B. Type I Dimmer Switch:

- 1. Source Limitations: Obtain products from single manufacturer.
- 2. Listing Criteria: UL CCN EOYX and UL 1472.
- 3. Standard Features:
 - a. UL 1472 Type I dimmer.
 - b. Device Color: As indicated on architectural Drawings.
 - c. Switch Style: Toggle.
 - d. Dimming Control Style: Slide.

- C. Air-Gap Fan-Speed Controller Switch:

- 1. Listing Criteria: UL CCN GQHG and UL 1917.
- 2. Standard Features:
 - a. Device Color: As indicated on architectural Drawings.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacles for Plugs and Attachment Plugs: UL CCN RTRT and UL 498.
 - b. Surge Protective Devices: UL 1449, Type 3.
2. Standard Features:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R.

B. Tamper-Resistant Duplex Straight-Blade Receptacle:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacles for Plugs and Attachment Plugs: UL CCN RTRT and UL 498.
 - b. Surge Protective Devices: UL 1449, Type 3.
2. Standard Features:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R.

2.4 RECEPTACLES WITH ARC-FAULT AND GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacle GFCIs: UL CCN KCXS, UL 498, and UL 943.
2. Standard Features:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration: Heavy-duty, NEMA 5-20R.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the

Contract Documents or manufacturer's published instructions, comply with the following:

1. Wiring Devices: NECA NEIS 130.
2. Mounting Heights: NECA NEIS 1.

3.2 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
1. Installing and Maintaining Wiring Devices: NECA NEIS 130.
 2. Mounting Heights: Unless otherwise indicated in the Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 3. Receptacle Orientation: Unless otherwise indicated in the Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.

3.3 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

- A. Tests and Inspections:
1. Insert and remove test plug to verify that device is securely mounted.
 2. Verify polarity of hot and neutral pins.
 3. Measure line voltage.
 4. Measure percent voltage drop.
 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
- B. Nonconforming Work:
1. Device will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.

3.4 PROTECTION

- A. Devices:
1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
 2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.
- B. Connectors, Cords, and Plugs:
1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- ###### **A. Electrical Components, Devices, and Accessories:** Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
2. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

2.3 NONFUSIBLE SWITCHES

- ###### **A. Type GD, General Duty, Three Pole, Single Throw, 240 V(ac), 600 A and Smaller:** UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- ###### **B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 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.

2.4 SHUNT TRIP SWITCHES

- ###### **A. General Requirements:** Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200 kA interrupting and short-circuit current rating.

- B. Type HD, Heavy-Duty, Fusible Switch; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Nonfusible Switch; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120 V(ac); obtained from integral control power transformer, with primary and secondary fuses, with control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.
- E. Accessories:
 - 1. Three-pole, double-throw, fire-safety and alarm relay; coil voltage as coordinated with Fire Alarm contractor.
 - 2. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
 - 3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating as required.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- B. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.
- C. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated or series rated as indicated on Drawings. Circuit breaker/circuit breaker combinations for series connected interrupting ratings must be listed by UL as recognized component combinations. Series rated combination used must be marked on end-use equipment along with statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."
- D. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- E. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.
- F. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- G. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
- H. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- I. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for

use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

- J. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).
- K. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).
- L. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

PART 3 - EXECUTION

3.1 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.
- C. Kitchen Areas: UL 50E, Type 4X, stainless steel.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. 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.
 - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - 3. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
 - 4. Install fuses in fusible devices.

3.3 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges to values indicated on Drawings.

3.4 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 32 13.13

DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diesel-engine-driven generator sets.
 - 2. Diesel engine.
 - 3. Diesel fuel-oil system.
 - 4. Control and monitoring.
 - 5. Generator overcurrent and fault protection.
 - 6. Generator, exciter, and voltage regulator.
 - 7. Outdoor engine generator enclosure.

1.2 DEFINITIONS

- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
 - 3. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIESEL-ENGINE-DRIVEN GENERATOR SETS

- A. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
 - 3. Comply with NFPA 110 requirements for Level 2 EPSS.
- C. UL Compliance: Comply with UL 2200.
- D. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 to 104 deg F.
 - 2. Relative Humidity: Zero to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Power Rating: Standby.
- D. Induction Method: Naturally aspirated.
- E. Governor: Adjustable isochronous, with speed sensing.
- F. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
- G. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
 - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- H. Engine Generator Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time:
 - a. Comply with NFPA 110, Type 10 system requirements.

2.4 DIESEL ENGINE

- A. Fuel: ASTM D975, diesel fuel oil, Grade 2-D S15.
- B. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump.
- C. Muffler/Silencer:
 1. Commercial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - a. Minimum sound attenuation of 12 dB at 500 Hz.
 - b. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 90 dBA or less.
- D. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- E. Starting System: 12-V electric, with negative ground.
 1. Cranking Cycle: As required by NFPA 110 for system level specified.
 2. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
 3. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
 4. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 5. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate

- in that mode until battery is discharged again.
- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

2.5 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 37.
- B. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for planned operation plus fuel for periodic maintenance operations between fuel refills.
 - 3. Leak detection in interstitial space.
 - 4. Vandal-resistant fill cap.
 - 5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- C. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Configuration:
 - 1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
- F. Control and Monitoring Panel:
 - 1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
 - 2. Instruments: Located on the control and monitoring panel and viewable during operation.
 - a. Engine lubricating-oil pressure gage.
 - b. Engine-coolant temperature gage.

- c. DC voltmeter (alternator battery charging).
 - d. Running-time meter.
 - 3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:
 - a. Cranking control equipment.
 - b. Run-Off-Auto switch.
 - c. Control switch not in automatic position alarm.
 - d. Overcrank alarm.
 - e. Overcrank shutdown device.
 - f. Low-water temperature alarm.
 - g. High engine temperature prealarm.
 - h. High engine temperature.
 - i. High engine temperature shutdown device.
 - j. Overspeed alarm.
 - k. Overspeed shutdown device.
 - l. Low fuel main tank.
 - 1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for duration required for the indicated EPSS class.
 - m. Coolant low-level alarm.
 - n. Coolant low-level shutdown device.
 - o. Coolant high-temperature prealarm.
 - p. Coolant high-temperature alarm.
 - q. Coolant low-temperature alarm.
 - r. Coolant high-temperature shutdown device.
 - s. EPS load indicator.
 - t. Battery high-voltage alarm.
 - u. Low cranking voltage alarm.
 - v. Battery-charger malfunction alarm.
 - w. Battery low-voltage alarm.
 - x. Lamp test.
 - y. Contacts for local and remote common alarm.
 - z. Low-starting air pressure alarm.
 - aa. Low-starting hydraulic pressure alarm.
 - bb. Remote manual stop shutdown device.
 - cc. Air shutdown damper alarm when used.
 - dd. Air shutdown damper shutdown device when used.
 - ee. Generator overcurrent-protective-device not-closed alarm.
 - ff. Hours of operation.
 - gg. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.
 - G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.
 - H. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- 2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION
- A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.
 - 1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective

- tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Overcurrent Protective Device:

1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:
 - a. Tripping Characteristic: Designed specifically for generator protection.
 - b. Trip Rating: Matched to generator output rating.
 - c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
 - d. Mounting: Adjacent to, or integrated with, control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
 1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
 2. Maintain voltage within 15 percent on one step, full load.
 3. Provide anti-hunt provision to stabilize voltage.
 4. Maintain frequency within 5 percent and stabilize at rated frequency within 2 seconds.
- D. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description:
 1. Vandal-resistant, sound-attenuating, weatherproof steel housing; wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
 - a. Sound Attenuation Level: As indicated on Drawings.
- B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
- C. Hinged Doors: With padlocking provisions.
- D. Space Heater: Thermostatically controlled and sized to prevent condensation.
- E. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

3.2 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two working days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
 - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 IDENTIFICATION

- A. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform tests recommended by manufacturer.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.

B. Coordinate tests with tests for transfer switches and run them concurrently.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCHES

PART 1 - GENERAL

A. Section Includes:

1. Contactor-type automatic transfer switches.
2. Molded-case-type automatic transfer switches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Contactor-type automatic transfer switches.
2. Molded-case-type automatic transfer switches.
3. Nonautomatic transfer switches.
4. Transfer switch accessories.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

1.3 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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. Comply with NEMA ICS 1.
- C. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- D. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 - 2. Short-time withstand capability for three cycles.
- E. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- F. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- G. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- H. Service-Rated Transfer Switch:
 - 1. Comply with UL 869A and UL 489.
 - 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
 - 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
 - 4. Provide removable link for temporary separation of the service and load grounded conductors.
 - 5. Ground-Fault Protection: Comply with UL 1008 for normal bus.
 - 6. Service Disconnecting Means: Externally operated, manual mechanically actuated.
- I. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- J. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- K. Battery Charger: For generator starting batteries.
 - 1. For generators less than 250 kW, float type, rated 10 A. Ammeter to display charging current.
 - 2. For generators 250 kW and larger, fused ac inputs and dc outputs.
- L. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed, tape shrinkable sleeve markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

4. Accessible via front access.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
 2. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 4. Material: Hard-drawn copper, 98 percent conductivity.
 5. Main and Neutral Lugs: Mechanical type.
 6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 7. Connectors shall be marked for conductor size and type according to UL 1008.
- B. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
 1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
 2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
 3. Fully automatic break-before-make operation with center off position.
- C. Manual Switch Operation, Load-Breaking: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: If building includes an elevator, provide a set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- F. Automatic Transfer-Switch Controller Features:
 1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal **[and Alternate]**Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

- a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: If required by paired generator, provide one isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
 - a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

2.3 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 1. Limitation: Switches using contactor-based components are unacceptable.
 2. Contacts: Silver composition or silver alloy for load-current switching.
 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 4. Material: Hard-drawn copper, 98 percent conductivity.
 5. Main and Neutral Lugs: Mechanical type.
 6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 7. Connectors shall be marked for conductor size and type according to UL 1008.
- B. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
 1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- C. Manual Switch Operation, Load-Breaking: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: If building includes an elevator, provide a set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control

panel.

F. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.

G. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal and Alternative Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
 - a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

2.4 TRANSFER SWITCH ACCESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.

2. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 - a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
 - b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
 - c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
 - d. Transition:
 - 1) Provide closed-transition operation when transferring from main transfer switch to bypass/isolation switch on the same power source.
 - e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
 - f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
 - g. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.
 - h. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
 - i. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
 - j. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
 3. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.
- B. Remote Annunciator System:
1. Source Limitations: Same manufacturer as transfer switch in which installed.
 2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
 3. Annunciation panel display shall include the following indicators:
 - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 - b. Switch position.
 - c. Switch in test mode.
 - d. Failure of communication link.
 4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 - a. Indicating Lights: Grouped for each transfer switch monitored.
 - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
 - d. Lamp Test: Push-to-test or lamp-test switch on front panel.
- C. Remote Annunciator and Control System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Include the following functions for indicated transfer switches:
 - a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 - b. Indication of switch position.
 - c. Indication of switch in test mode.
 - d. Indication of failure of digital communication link.
 - e. Key-switch or user-code access to control functions of panel.
 - f. Control of switch-test initiation.
 - g. Control of switch operation in either direction.
3. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
4. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
 - a. Controls and indicating lights grouped together for each transfer switch.
 - b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
 - c. Digital Communication Capability: Matched to that of transfer switches supervised.
 - d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- D. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, **[motor controls]**, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- C. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- D. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than **18 inches** in length.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
 - k. Perform visual and mechanical inspection of surge arresters.
 - l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
3. Electrical Tests:
 - a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Verify settings and operation of control devices.
 - c. Calibrate and set all relays and timers.
 - d. Verify phase rotation, phasing, and synchronized operation.
 - e. Perform automatic transfer tests.
 - f. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.

- d. Perform manual transfer operation.
 - 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 - 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
 - B. Coordinate tests with tests of generator and run them concurrently.
 - C. Remove and replace malfunctioning units and retest as specified above.
- 3.4 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
 - B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Type 2 surge protective devices (SPDs).
 - 2. Enclosures.
 - 3. Conductors and cables.

1.2 DEFINITIONS

- A. In: Nominal discharge current.
- B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.
- D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).
- E. SCCR: Short-circuit current rating.
- F. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- G. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
 - a. Include electrical characteristics, specialties, and accessories for SPDs.

PART 2 - PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

- A. Source Limitations: Obtain devices from single source from single manufacturer.

B. General Characteristics:

1. Reference Standards: UL 1449, Type 2; UL 1283.
2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits must not exceed the following:
 - a. Line to Neutral: 700 V for 208Y/120 V.
 - b. Line to Ground: 700 V for 208Y/120 V.
 - c. Neutral to Ground: 700 V for 208Y/120 V.
 - d. Line to Line: 1200 V for 208Y/120 V.
5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
 - a. Line to Neutral: 700 V.
 - b. Line to Ground: 700 V.
 - c. Neutral to Ground: 700 V.
 - d. Line to Line: 1200 V.
6. SCCR: Equal or exceed 100 kA.
7. In Rating: 20 kA.

C. Options:

1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.

2.2 ENCLOSURES

- A. Indoor Enclosures: Type 1.
- B. Outdoor Enclosures: Type 3R.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.
- B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions.
 1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.

- 2. Do not exceed manufacturer's recommended lead length.
- 3. Do not bond neutral and ground.
- C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

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

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 LUMINAIRES

- A. Surface-Mounted Luminaire:

- 1. Listing Criteria:

- a. LED Luminaires: UL CCN IFAM; including UL 1598.

- 2. Standard Features:

- a. LED Luminaires (UL CCN IFAM):

- 1) Refer to LIGHTING FIXTURE SCHEDULE

- B. Recessed Luminaire:

- 1. Listing Criteria:

- a. LED Luminaires: UL CCN IFAO; including UL 1598

- 2. Standard Features:

- a. Ceiling Compatibility: NEMA LE 4.
 - b. LED Luminaires (UL CCN IFAO):

- 1) Refer to LIGHTING FIXTURE SCHEDULE.

C. UL IFFR - Track-Lighting Systems:

1. Listing Criteria:
 - a. Track Lighting: UL CCN IFFR; including UL 1574.
2. Standard Features:
 - a. Refer to LIGHTING FIXTURE SCHEDULE.

D. UL FTBR or FTBV - Emergency Lighting and Power Equipment:

1. Listing Criteria:
 - a. Emergency Lighting and Power: UL CCN FTBR or UL CCN FTBV; including UL 924, NFPA 101, and ICC IBC.
 - b. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
2. Standard Features:
 - a. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 - b. Status and Test Indication: Visible and accessible without opening luminaire or entering ceiling space.
 - 1) Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 2) Test Push-Button: Push-to-test button in unit housing simulates loss of normal power and demonstrates unit operability.
 - c. Refer to LIGHTING FIXTURE SCHEDULE.

E. UL FWBO - Exit Fixture:

1. Listing Criteria:
 - a. Exit Fixtures: UL CCN FWBO; including UL 924, NFPA 101, NFPA 5000, and ICC IBC.
 - b. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
2. Standard Features:
 - a. Light Source: LED; 50,000 hours minimum rated life.
 - b. Internal emergency power unit.
 - c. Refer to LIGHTING FIXTURE SCHEDULE.

2.3 LUMINAIRE FITTINGS

A. Luminaire Support Accessories:

1. Standard Features:
 - a. Sized and rated for luminaire weight.
 - b. Capable of maintaining luminaire position after cleaning and relamping.
 - c. Capable of supporting luminaire without causing deflection of ceiling or wall.
 - d. Capable of supporting horizontal force equal to 100 percent of luminaire weight and vertical force equal to 400 percent of luminaire weight.

2. Other Available Features Required by the Project:
 - a. Hook Hangers: Integrated assembly matched to luminaire, supply voltage, and equipment with threaded attachment, cord, and locking-type plug.
 - b. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage wire supports adjustable to , 10 ft in length.
 - c. Aircraft Cables: 5/32 inch diameter aircraft cable supports adjustable to , 10 ft in length.
 - d. Single-Stem Hangers: **1/2 inch** nominal diameter steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
 - e. Rod Hangers: **3/16 inch** nominal diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 1. Installation of Indoor Lighting Systems: NECA NEIS 500.
 2. Installation of Exterior Lighting Systems: NECA NEIS 501.
- C. Special Installation Techniques:
 1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
 2. Install luminaires at height and aiming angle as indicated on the Drawings.
 3. Coordinate layout and installation of luminaires with other construction.
 4. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
 5. Exterior Bollard Luminaires:
 - a. Align units for optimum directional alignment of light distribution.
 6. Exterior In-Ground Luminaires:
 - a. Install on concrete base with top 4 inch above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."
 7. Exterior Corrosion Prevention:
 - a. Do not use aluminum in contact with earth or concrete. When in direct contact with dissimilar metals, protect aluminum with insulating fittings or treatment.
 - b. When embedding steel conduits in concrete, wrap conduit with **10 mil** thick, pipe-wrapping plastic tape applied with a 50 percent overlap.
 8. Flush-Mounted Luminaire Support:
 - a. Secured to outlet box.
 - b. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - c. Trim ring flush with finished surface.
 9. Wall-Mounted Luminaire Support: Attached to structural members in walls.

- a. Do not attach luminaires directly to gypsum board.
- 10. Suspended Luminaire Support:
 - a. Ceiling Mount:
 - 1) Hook hangers.
 - 2) Two wires.
 - 3) Two aircraft cables.
 - b. Pendants and Rods: Where longer than **48 inch**, brace to limit swinging.
 - c. 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.
 - d. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 - e. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- 11. Ceiling-Grid-Mounted Luminaire Support:
 - a. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than **6 inch** from luminaire corners.
 - b. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for application.
 - c. Luminaires of Sizes Smaller than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with no fewer than two **3/4 inch** metal channels spanning and secured to ceiling tees.
- 12. Remote Mounting of Ballasts or Drivers: Do not exceed distance between ballast or driver and luminaire recommended by ballast or driver manufacturer.
- 13. Emergency Power Units: Secure with approved fasteners in four or more locations, spaced near corners of unit.
- 14. Install wiring connections for luminaires.
- D. Systems Integration: Integrate lighting control devices and equipment with electrical power connections for operation of luminaires as specified.

3.2 FIELD QUALITY CONTROL OF LIGHTING

- A. 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.
 - 3. Verify operation of photoelectric controls.
- B. Nonconforming Work:
 - 1. Luminaire will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.

3.3 PROTECTION

- A. After installation, protect lighting equipment from construction activities. Remove and replace items that

are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 27 15 13

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Category 6 twisted pair cable.
 - 2. Twisted pair cable hardware.
 - 3. Identification products.

1.2 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. FTP: Shielded twisted pair.
- D. F/FTP: Overall foil screened cable with foil screened twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- H. LAN: Local area network.
- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.
- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- M. S/FTP: Overall braid screened cable with foil screened twisted pair.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- O. UTP: Unscreened (unshielded) twisted pair.

1.3 ACTION SUBMITTALS

- A. Product Data:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware.

1.4 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 1. Communications, Plenum Rated:
 - a. Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
 2. Communications, Non-Plenum Rated:
 - a. Type CMR complying with UL 1666.
- B. 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: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Category 6 Twisted Pair Cable: Four-pair, balanced -twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Shielded twisted pairs (FTP).
- E. Cable Rating: Riser or Plenum as required for space.

- F. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

- A. Twisted Pair Cable Hardware: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568-C.2.
- D. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or cover plate.
 - 3. Standard: Comply with TIA-568-C.2.
- E. Cover Plate:
 - 1. Six port, vertical single gang cover plates designed to mount to single gang wall boxes.
 - 2. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533.16 "Boxes and Covers for Electrical Systems."
 - 3. Metal Cover Plate: Stainless steel
 - 4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- F. Legend:
 - 1. Machine printed, in the field, using adhesive-tape label.
 - 2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Routing:

1. Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.
 - a. Install plenum cable in environmental air spaces, including plenum ceilings.
 - B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.
- 3.2 INSTALLATION OF TWISTED PAIR HORIZONTAL CABLES
- A. Comply with NECA 1 and NECA/BICSI 568.
 - B. General Requirements for Cabling:
 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 11. In the communications equipment room, install a 6-foot- long service loop on each end of cable.
 12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
 - C. Open-Cable Installation:
 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
 - D. Separation from EMI Sources:
 1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

3.3 FIRESTOPPING

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with "Firestopping Systems" Article in BISC's "Telecommunications Distribution Methods Manual."

3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B.
 1. Administration Class: Class 2.
 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Cable and Wire Identification:
 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
- C. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and

- inspect cabling connections for compliance with TIA-568-C.1.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- B. Nonconforming Work:
1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

END OF SECTION

SECTION 28 31 11

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals, make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. UL listed and labeled.
- 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.

2.2 SYSTEM DESCRIPTION

- A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
- 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.
- C. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
- D. 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.
- E. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station if present.
- F. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, and trouble signals 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.

- G. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
- H. 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.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
 - 1. Single-action mechanism, breaking-glass or plastic-rod type. With integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

2.5 SYSTEM SMOKE DETECTORS

- A.
- B. General Requirements for System Smoke Detectors: Comply with UL 268.
- C. Photoelectric Smoke Detectors: 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.

2.6 NONSYSTEM SMOKE DETECTORS

- A. Single-Station Smoke Detectors: Comply with UL 217 and UL 464; suitable for NFPA 101, residential occupancies; operating at 120-V ac **with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.**

2.7 HEAT DETECTORS

- A.
- B. General Requirements for Heat Detectors: Comply with UL 521.
- C. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

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.
- B. Horns: Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

- C. Visible Notification Appliances: Strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

- 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.

2.9 MAGNETIC DOOR HOLDERS

- A. Description: Equipped for wall or floor mounting, complete with matching doorplate.
- B. Material and Finish: Match door hardware.

2.10 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.

2.11 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel in existing part of the building.
 - 2. Connect new equipment to existing monitoring equipment at the supervising station.
 - 3. Expand, modify, and supplement existing **control** and **monitoring** equipment as necessary to extend existing **control** and **monitoring** functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

3.2 FIELD QUALITY CONTROL

- A. Provide field tests and inspections as required by authorities having jurisdiction.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

1.3 QUALITY ASSURANCE

- A. Clearing Firm: Company specializing in the type of work required.
 - 1. Minimum of three years of documented experience.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fill Material: As specified in Section 312300 - Earthwork.

PART 3 EXECUTION

3.1 PREPARATION

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
- B. Salvagable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify Utility Notification Center of local jurisdiction before site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation-control and plant protection measures are in place.
- E. Protect and maintain benchmarks and survey control points from disturbance.
- F. Protect site improvements to remain from damage. Restore damaged improvements to condition existing before start of site clearing.
- G. Do not store materials or equipment or permit excavation within drip line of remaining trees.
- H. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the Erosion Control Drawings, as approved by local jurisdiction.
- I. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

3.2 SITE CLEARING

- A. Comply with other requirements specified in Section 01 70 00.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- C. Protect remaining trees and shrubs from damage and maintain vegetation. Employ a licensed arborist to repair tree and shrub damage. Restore damaged vegetation. Replace damaged trees that cannot be restored to full growth, as determined by arborist.
- D. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
- E. Strip topsoil. Stockpile topsoil that will be reused in the Work.
- F. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- G. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

- H. In areas not to be further excavated, fill depressions resulting from site clearing. Place and compact satisfactory soil materials in 8-inch-thick layers to density of surrounding original ground.
- I. Dispose of waste materials, including trash, debris, and excess topsoil, off Owner's property. Burning waste materials on-site is not permitted.

3.3 VEGETATION

- A. Install substantial, highly visible fences at least 3 feet high (at least 1 m high) to prevent inadvertent damage to vegetation to remain.
- B. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- C. Vegetation Removed: Do not burn, bury, landfill, or leave on site.
 - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
 - 3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- D. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.4 DEBRIS

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

END OF SECTION

SECTION 31 20 00 - EARTHWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Section 31 10 00 "Site Clearing".
- B. Soils investigation report.

1.2 SECTION INCLUDES

- A. Provide complete earthwork including:
 - 1. Removing and hauling off topsoil.
 - 2. General excavation, excavation for structures and footings.
 - 3. Rough grading
 - 4. Fill and backfill
 - 5. Finish grading.
 - 6. Shoring and bracing excavations with temporary shoring, sheeting or retention system as required by code law or ordinance to protect excavation area, workers, nearby streets and structures.
- B. Note: Refer to the soils investigation report and to recommendations of the soils engineer. If anything contained herein is contradictory to such report or recommendations, the report and recommendations of the soils engineer shall govern.

1.3 SITE CONDITIONS

- A. Actual site conditions that differ from those of the bidding period and which affect site clearing operations shall be brought to the attention of the Owner prior to the commencement of any site work.

1.4 REFERENCE STANDARDS

- A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- B. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.

1.5 SUBMITTALS

- A. Samples: Submit data on each type of fill material to be used as requested by Civil Engineer and Owner.

1.6 BASIS FOR BIDS

- A. Bids shall be based on excavating and filling with materials encountered at site except where special fill or backfill materials are specified herein or indicated on Drawings. No allowance or extra payments will be made by reason of variation in types of soil encountered or variations in their moisture contents.

1.7 QUALITY ASSURANCE

- A. Shoring, sheeting, bracing and retention plans, details and other provisions necessary in order to safely excavate trenches for this project shall be prepared by a Professional Engineer registered in the State where the project is constructed and employed by Contractor. The Contractor shall be solely responsible for retention plans, details, accessories and execution.

1.8 PROTECTION

- A. Protect trees, shrubs, lawns, rock outcroppings and other features remaining as a portion of final landscaping.
- B. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular traffic.
- C. Protect above and below grade utilities which are to remain.
- D. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation. Monitor shoring system and surrounding ground surface during construction to detect movement. If movement becomes significant, take contingency steps to brace excavation and adjacent utility lines.

- E. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.
- F. Notify Architect and Owner of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
- G. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- H. Grade excavation top perimeter to prevent surface water run-off into excavation.

1.9 COORDINATION

- A. Coordinate excavation work with other trades for proper scheduling of work. Accurately record location of utilities to remain prior to beginning work, including horizontal dimensions, inverts and slope gradients.

1.10 TESTING

- A. Will be performed in accordance with the provisions of Section 01 40 00.

1.11 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 70 00.

PART 2 PRODUCTS

2.1 STOCKPILING

- A. Material cut or excavated from building areas which is suitable for backfilling may be stored on site to be distributed later. Fill material required to be hauled in may be stockpiled at site until used, provided it is properly handled to prevent contamination with undesirable materials. Stockpile topsoil separate from excavated sub-soil.

2.2 SURPLUS MATERIALS

- A. Excavated materials not to be used in fills and backfills on this project shall be immediately removed from site. Materials containing rubbish, debris or rocks shall be removed.

2.3 MATERIALS

- A. General Fill and Backfill: Suitable existing excavated on-site soil free from vegetation, debris, and other deleterious matter, unless otherwise noted.
- B. Fill Beneath Structures: Inert and non-expansive, having a plasticity index, liquid limit, and other characteristics in accordance with the soil investigation report.
- C. Top Soil
 - 1. Clean natural topsoil free of vegetation, debris and other deleterious matter.
 - 2. Provide topsoil free from weeds, nutgrass, lumps, stones larger than 1 inch, roots, destructive seeds, noxious chemicals, brush, debris litter or similar substances.

2.4 SHORING AND BRACING

- A. Contractor shall design and provide as necessary to prevent cave-ins and slides, or as a protection for workmen in trenches and other excavation. Shoring and bracing shall remain in place as long as required for safety and shall be removed only as backfill is placed. Comply with all Municipal, State, and Federal requirements. Shoring and bracing shall be designed by a licensed professional engineer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Establish extent of excavation by area and elevation; designate and identify datum elevation.
- B. Set required lines and levels.
- C. Maintain bench marks, monuments and other reference points indicated to remain.

3.2 PREPARATION

- A. Before starting excavation, establish location and extent of underground utilities occurring in work area.
- B. Notify utility companies to remove and relocate lines which are in the way of excavation.
- C. Maintain, reroute or extend as required, existing utility lines to remain which pass through work area.

- D. Protect utility services uncovered by excavation.
- E. Remove abandoned utility service lines from areas of excavation; cap, plug or seal such lines and identify at grade.
- F. Accurately locate and record abandoned and active utility lines rerouted or extended on Project Record Documents.
- G. Upon discovery of unknown utility or concealed condition, discontinue affected work and notify Architect and Owner.
- H. Surface grades shall provide for positive drainage away from structures and shall be uniformly smooth throughout.

3.3 PERMITS AND FEES

- A. Obtain all required construction permits associated with the work of this Section.

3.4 ROUGH GRADING

- A. Excavation and rough grade to lines and grades shown.
- B. Overcut new planting and lawn areas to allow a layer of topsoil not less than 4" thick or as indicated in the Landscape Drawings.
- C. Maintain excavations to drain and be free of excess water.
- D. Remove objectionable and excess materials from site when excavated.

3.5 STRUCTURAL EXCAVATION

- A. Locate and mark all existing underground utilities and services before beginning structural excavation.
- B. Provide excavation for structures and footings, as required for construction, bracing and removal of forms, applying waterproofing, and to permit inspection.
- C. Machine slope banks to angle of repose or less until shored. Excavation shall not interfere with normal 45 degree angle bearing splay of any foundation.
- D. Bottom of excavating shall be reasonably level.
- E. Maintain excavations in as near their natural moisture conditions as possible.
- F. Fill over-excavated areas under structure bearing surfaces in accordance with Soil Engineer's direction.
- G. Do not allow construction equipment to create "pumping" of soils.
- H. Stockpile excavated clean fill for reuse where directed. Remove excess or unsuitable excavated fill from site.
- I. Remove boulders or cobbles. Use of explosives will not be permitted.
- J. Coordinate with drilled pier work for special requirements and arrangements regarding excavation to rough out elevations.
- K. If presence of perched water is encountered, provide interior drainage. Take every precaution to prevent water from entering, softening, and undercutting excavated areas, including pits, footings, trenches, etc.

3.6 EXCAVATION BENEATH FLOOR SLABS

- A. Beneath Floor Slab on Grade: Refer to recommendations of the soils engineer.

3.7 FILLS AND BACKFILLS - GENERAL

- A. Verify areas to be backfilled are free of debris, snow, ice or water, and ground surfaces are not frozen.
- B. Proofroll exposed subgrade in building and paving areas to detect unsuitable soil conditions. Commence proofrolling operations after a suitable period of dry weather to avoid degrading acceptable subgrade surfaces. Make four passes over each section with proofrolling equipment, with the last two perpendicular to the first two.
- C. Cut out soft areas of subgrade not readily capable of in-situ compaction. Backfill and compact to density equal to requirements for subsequent backfill material.
- D. Site backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet or spongy subgrade surfaces.
- E. Use a placement method that will not disturb or damage utilities in trenches.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Make gradual changes in grade. Blend slopes into level areas.
- H. Refer to soils investigation report for additional requirements.

3.8 FILLS (WITHIN STRUCTURE)

- A. Select Fill Beneath Slabs on Grade: (refer to soils report for specific fill placement criteria)
 - 1. Scarify exposed sub-grade and recompact to an appropriate density determined using Standard Proctor Compaction Test, at moisture content as indicated in soil report.
 - 2. Place appropriate fill in loose lifts and compact each lift to an appropriate density determined using Standard Proctor Compaction Test, at moisture content as indicated in soil report.
 - 3. Place select fill to a minimum depth indicated on drawings.
 - 4. Prevent excessive loss of moisture during construction.
- B. Refer to soils investigation report for additional requirements.

3.9 FILLS (OUTSIDE STRUCTURE)

- A. Roughen and loosen filled areas before placing of fill materials.
- B. Spread suitable fill materials in uniform layers over area not to exceed 8" thick compaction.
- C. Wet and work materials as required for proper compaction and thoroughly mix. Compaction shall be by tamping rollers or by utilizing excavation equipment to spread and compact fill to a uniform density equal to natural density of material before excavating.
- D. Areas adjacent to building, or where compacting equipment cannot work, shall be compacted with hand tampers.
- E. Scarify upper 6 inches of exposed sub-grade and compact filled areas to density as indicated in the soils report, to lines and grades shown, with allowances for a final layer of topsoil at least 4 inches thick in lawn and planter areas.
- F. Plant Beds: Refer to landscape drawings. Beds shall be prepared to a minimum of 4 inches of depth.

3.10 BACKFILL (OUTSIDE STRUCTURE)

- A. Ensure areas to be backfilled are free from debris, snow, ice and water and that ground surfaces are not in frozen condition.
- B. Do not backfill over existing subgrade surfaces which are porous, wet or spongy.
- C. Backfill areas to grades, contours, levels and elevations indicated.
- D. Backfill systematically and as early as possible to allow maximum time for natural settlement and compaction.
- E. After permanent construction is in place, forms and trash removed, sub-soil drainage and water-proofing complete and inspections complete, backfill with approved materials and compact to approximate density of natural ground.
- F. Place backfill in layers not exceeding 8" loose depth, and hand or machine tamp to compaction required.
- G. Water may be added to backfill material as an aid to compaction; however, material shall not be wet to form a mud or paste.

3.11 REMOVAL OF CONTAMINATED SOIL

- A. Prior to finish grading: Soil contaminated with lime should be removed from lawn and plant bed areas. Replace with clean, approved topsoil.

3.12 FINISH GRADING

- A. After rough grading has been completed and site cleared of construction debris, cover areas disturbed by construction or graded to provide new finish grades with a layer of topsoil not less than 4" thick.
- B. Reuse stockpiled topsoil, cleaned of foreign matter, or provide additional approved topsoil as required.
- C. Final grades shall be as shown or as directed by Landscape Architect and shall slope away from building and shall provide drainage for area.
- D. Degree of finish shall be that ordinarily obtainable with blade grader or scraper operations.
- E. Finish surfaces shall be not be more than 0.10 feet above or below established grade elevation.
- F. Provide uniform roundings at top and bottom of slopes and other breaks in grade. Correct irregularities and areas where water will stand.
- G. Uniformly distribute topsoil to required grades; feather back to where grades remain unchanged.
- H. Finish lawn and unpaved areas to 1" below top of walk and curbs.

3.13 PROTECTION, CLEAN-UP AND EXCESS MATERIALS

- A. Protect grades from construction and weather damage, washing, erosion and rutting, and repair such damage that occurs.
- B. Correct any settlement below established grades to prevent ponding of water.
- C. At locations where lime, concrete or other foreign matter has penetrated or been mixed with earth, remove damaged earth and replace with clean material.
- D. Remove excess stockpiled material, debris, waste, and other material from site and leave work in clean finished condition for final acceptance. Contractor is responsible for disposal of debris and excess materials.

3.14 QUALITY CONTROL

- A. Paving Subgrade Stabilization: Perform one subgrade in-place density test per 7,500 S.F. of subgrade, after subgrade preparation is complete at locations determined by the soils engineer, in accordance with ASTM D6938. Perform tests within 48 hours of placement of pavement construction.
- B. Building Subgrade Stabilization: Make necessary soil tests (Atterberg Limit Series and ASTM D698 Standard Proctor for each type of fill specified) to determine the moisture content and density of existing subgrade and inspect and test the placement of additional fill lifts to verify that all fill materials used are in accordance with the specifications for that use. Perform one field density test (ASTM D6938) for each 5,000 S.F. of area within the building footprint on each lift prior to placement of additional fill material.

END OF SECTION

SECTION 31 31 16 - TERMITE CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Chemical soil treatment.

1.2 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2019.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this Section; require attendance by all affected installers.
 - 1. Convene under general provisions of Section 01 70 00.
 - 2. Discuss application requirements, procedures, and limitations.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.
- D. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.
- E. Manufacturer's Instructions: Indicate caution requirement and recommended application rates.
- F. Record and document moisture content of soil before application.
- G. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of three (3) years documented experience.
 - 2. Licensed in the State in which the Project is located.

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. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
 - 1. Inspect annually and report in writing to Owner. Provide inspection service for five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Bayer Environmental Science Corp.: www.backedbybayer.com/pest-management.
 - 2. FMC Professional Solutions: www.fmcprosolutions.com.
 - 3. Syngenta Professional Products: www.syngentaprofessionalproducts.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y and local authority approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Mixes: Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. 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.
- C. Proceed with application only after unsatisfactory conditions have been corrected.
- D. Verify final grading is complete.

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 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
 - 1. Under slabs-on-grade.
 - 2. At both sides of grade beams and foundation walls.
 - 3. Soil within 10 feet (3 m) of building perimeter for a depth of 3 feet (1 m).
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.4 PROTECTION

- A. Do not permit soil grading over treated work.
- 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.

3.5 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include twelve months' full maintenance by skilled employees of termite-control-treatment Installer or manufacturer's authorized service representative. Include quarterly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

- B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION

SECTION 32 17 13 - PARKING BUMPERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete parking bumpers and anchorage.

1.2 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- D. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Parking Bumpers: Precast concrete, complying with the following:
 - 1. Profile: Manufacturer's standard.
 - 2. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
 - 3. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 - 4. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 - 5. Air Entrainment Admixture: ASTM C260/C260M.
 - 6. Concrete Mix: Minimum 5,000 psi (34 MPa) compressive strength after 28 days, air entrained to 5 to 7 percent.
 - 7. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
 - 8. Embed reinforcing steel, and drill or sleeve for two dowels.
 - 9. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
 - 10. Minor patching in plant is acceptable, providing appearance of units is not impaired.
- B. Dowels: Steel, unfinished; 1/2 inch (12 mm) diameter, 12 inch (600 mm) long, pointed tip.

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 2 dowels per unit.

END OF SECTION

SECTION 32 17 23.13 - PAINTED PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Parking lot markings, including parking bays, crosswalks, arrows, and handicapped symbols.

1.2 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- B. FHWA MUTCD - Manual on Uniform Traffic Control Devices; 2023.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons (18 L) accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.4 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Line and Zone Marking Paint: MPI No. 97 Latex Traffic Marking Paint; color(s) as specified.
 - 1. Drive Lanes and Directional Symbols: White.
 - 2. Parking Stalls: White.
 - 3. Handicapped Symbols: Blue and white.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
 - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.

3.3 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F (10 degrees C) or more than 95 degrees F (35 degrees C).

- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
 - D. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
 - E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
 - F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the Drawings true, sharp edges and ends.
 - 1. Apply paint in one coat only.
 - 2. Wet Film Thickness: 0.015 inch (0.4 mm), minimum.
 - 3. Length Tolerance: Plus or minus 2 inches (50 mm).
 - 4. Width Tolerance: Plus or minus 1/8 inch (3 mm).
 - G. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on Drawings.
 - 1. Mark the International Handicapped Symbol at indicated parking spaces.
 - 2. Hand application by pneumatic spray is acceptable.
 - H. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.
- 3.4 DRYING, PROTECTION, AND REPLACEMENT
- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
 - B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
 - C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
 - D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
 - E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
 - F. Replace removed markings at no additional cost to Owner.

END OF SECTION