PROJECT MANUAL

PROJECT:

DISTRICT ADMINISTRATION BUILDING
BID PACKAGE 5

OWNER:

TROY SCHOOL DISTRICT
4400 Livernois Road
Troy, Michigan 48098

TMP PROJECT NOS.: 22106

DATE: June 23, 2025

ISSUED FOR: CONSTRUCTION DOCUMENTS

ARCHITECT

TMP ARCHITECTURE, INC.
1191 West Square Lake Road
Bloomfield Hills, Michigan 48302-0374

PH 248-338-4561
Email info@tmp-architecture.com

CONSTRUCTION MANAGER

BARTON MALOW
26500 American Drive
Southfield, Michigan 48034

PH (248) 436-5000

Copyright (c) 2025 TMP Architecture, Inc.

STRUCTURAL ENGINEER CONSULTANT

WILLIAM A. KIBBE & ASSOCIATES, INC.
1475 South Washington Ave.
Saginaw, Michigan 48601

PH (989) 752-5000

MECHANICAL ENGINEER CONSULTANT

PETER BASSO ASSOCIATES, INC.
5145 Livernois Road, Suite 100
Troy, Michigan 48098-3276

PH (248) 879-5666
Email info@pbanet.com

ELECTRICAL ENGINEER CONSULTANT

PETER BASSO ASSOCIATES, INC.
5145 Livernois Road, Suite 100
Troy, Michigan 48098-3276

PH (248) 879-5666
Email info@pbanet.com

TABLE OF CONTENTS

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

Section	Title	Issued
00 0101	Title Page	**CD**
00 0107	Professional Seals Page	**NOT ISSUED**
00 0110	Table of Contents	**CD**
00 0115	List of Drawings	**CD**
00 8200	Availability of Electronic Files	**CD**
00 8200.02	Electronic Files Release Form (Free)	**CD**

SPECIFICATIONS GROUP

GENERAL REQUIREMENTS SUBGROUP

DIVISION 01 - GENERAL REQUIREMENTS

Section	Title	Issued
01 2200	Unit Prices	**CD**
01 2300	Alternates	**CD**
01 2500	Substitution Procedures	**CD**
01 2500.01	TMP Substitution Request Form	**CD**
01 3000	Administrative Requirements	**CD**
01 3000.01	TMP Submittal and Sample Transmittal Form	**CD**
01 4000	Quality Requirements	**CD**
01 4100	Regulatory Requirements	**CD**
01 4216	Definitions	**CD**
01 4219	Reference Standards	**CD**
01 4533	Code-Required Special Inspections and Procedures	**CD**
01 6000	Product Requirements	**CD**
01 7000	Execution and Closeout Requirements	**CD**
01 7327	Cutting and Patching of Single Ply Roofing	**CD**
01 7329	Cutting and Patching	**CD**
01 7800	Closeout Submittals	**CD**

FACILITY CONSTRUCTION SUBGROUP

DIVISION 02 – EXISTING CONDITIONS

Section	Title	Issued

02 4100	Demolition	**CD**

DIVISION 03 - CONCRETE

Section	Title	Issued
03 3000	Cast-in-Place Concrete	**CD**
03 3003	Cast-in-Place Concrete Requirements for Floor Slabs	**CD**
03 5400	Cast Underlayment	**CD**

DIVISION 04 - MASONRY

Section	Title	Issued
04 0100	Maintenance of Masonry	**CD**

DIVISION 05 - METALS

Section	Title	Issued
05 5000	Metal Fabrications	**CD**

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

Section	Title	Issued
06 1000	Rough Carpentry	**CD**
06 4023	Interior Architectural Woodwork	**CD**

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section	Title	Issued
07 8400	Firestopping	**CD**
07 9200	Joint Sealants	**CD**

DIVISION 08 - OPENINGS

Section	Title	Issued
08 1113	Hollow Metal Doors and Frames	**CD**
08 1416	Flush Wood Doors	**CD**
08 1610	FRP-Faced Aluminum Doors	**CD**
08 3100	Access Doors and Panels	**CD**
08 4313	Aluminum-Frames Storefronts	**CD**
08 5800	Aluminum Interior Sliding Service Window	**CD**
08 7100	Door Hardware	**CD**
08 8000	Glazing	**CD**

08 8300	Mirrors	**CD**

DIVISION 09 - FINISHES

Section	Title	Issued
09 0561	Common Work Results for Flooring Preparation	**CD**
09 2216	Non-Structural Metal Framing	**CD**
09 2900	Gypsum Board	**CD**
09 3000	Hard Tiling	**CD**
09 5100	Acoustical Ceilings	**CD**
09 6500	Resilient Flooring	**CD**
09 6513	Resilient Base and Accessories	**CD**
09 6813	Tile Carpeting	**CD**
09 7200	Wall Coverings	**CD**
09 8433	Acoustic Wall Units	**CD**
09 8436	Acoustic Ceiling Units	**CD**
09 9123	Interior Painting	**CD**

DIVISION 10 - SPECIALTIES

Section	Title	Issued
10 1100	Visual Display Units	**CD**
10 1419	Dimensional Letter and Signage	**CD**
10 2113.15	FRP-Clad Toilet Compartments	**CD**
10 2600	Wall and Door Protection	**CD**
10 2800	Toilet, Bath, and Laundry Accessories	**CD**
10 4400	Fire Protection Specialties	**CD**

DIVISION 11 - EQUIPMENT

Not Used

DIVISION 12 - FURNISHINGS

Section	Title	Issued
12 2400	Window Shades	**CD**
12 3216	Manufactured Plastic Laminate-Clad Casework	**CD**
12 3600	Countertops	**CD**

DIVISION 13 - SPECIAL CONSTRUCTION

Not Used

DIVISION 14 - CONVEYING EQUIPMENT

Not Used

FACILITY SERVICES SUBGROUP

DIVISION 20 – COMMON MECHANICAL REQUIREMENTS

Section	Title	Issued
20 0500	Mechanical General Requirements	**CD**
20 0510	Basic Mechanical Materials and Methods	**CD**
20 0513	Motors	**CD**
20 0516	Pipe Flexible Connectors, Expansion Fittings and Loops	**CD**
20 0519	Meters and Gages	**CD**
20 0529	Hangers and Supports	**CD**
20 0547	Mechanical Vibration Controls	**CD**
20 0553	Mechanical Identification	**CD**
20 0700	Mechanical Insulation	**CD**

DIVISION 21 – FIRE SUPPRESSION

Not Used

DIVISION 22 - PLUMBING

Section	Title	Issued
22 0523	Under-Lavatory Pipe and Supply Covers	**CD**
22 1116	Domestic Water Piping	**CD**
22 1119	Domestic Water Piping Specialties	**CD**
22 1316	Sanitary Waste and Vent Piping	**CD**
22 1319	Drainage Piping Specialties	**CD**
22 1413	Storm Drainage Piping	**CD**
22 4200	Plumbing Fixtures	**CD**
22 4700	Drinking Fountains, Water Coolers and Cupsidors	**CD**

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING (HVAC)

Section	Title	Issued
23 0500	Common Work Results for HVAC	**CD**
23 0523	General-Duty Valves for HVAC	**CD**
23 0593	Testing, Adjusting, and Balancing	**CD**
23 0933	Temperature Controls	**CD**
23 2113	Hydronic Piping	**CD**
23 2510	Piping Systems Flushing and Chemical Cleaning	**CD**
23 3113	Metal Ducts	**CD**
23 3300	Duct Accessories	**CD**
23 3423	Power Ventilators	**CD**

23 3600	Air Terminal Units	**CD**
23 3713	Diffusers, Registers, and Grilles	**CD**
22 8229	Electrical and Hydronic Radiant Heating Units	**CD**
23 8233	Convection Heating Units	**CD**
23 8240	Centrifugal Fan Cabinet Unit Heaters (Hot Water)	**CD**

DIVISION 25 – INTEGRATED AUTOMATION

Not Used

DIVISION 26 – ELECTRICAL

Section	Title	Issued
26 0010	Electrical General Requirements	**CD**
26 0519	Conductors and Cables	**CD**
26 0526	Grounding and Bonding	**CD**
26 0529	Hangers and Supports for Electrical Systems	**CD**
26 0533	Raceways and Boxes	**CD**
26 0553	Electrical Identification	**CD**
26 0573	Overcurrent Protective Device Coordination and Arc-Flash Hazard Study	**CD**
26 0923	Lighting Control Devices	**CD**
26 0943	Lighting Control Systems	**CD**
26 0999	Electrical Testing	**CD**
26 2416	Panelboards	**CD**
26 2726	Wiring Devices	**CD**
26 2813	Fuses	**CD**
26 2816	Enclosed Switches	**CD**
26 2913	Enclosed Controllers	**CD**
26 5119	LED Interior Lighting	**CD**

DIVISION 27 – COMMUNICATIONS

Not Used

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Section	Title	Issued
28 3100	Fire Alarm	**CD**

SITE AND INFRASTRUCTURE SUBGROUP

DIVISION 31 – EARTHWORK

Not Used

DIVISION 32 – EXTERIOR IMPROVEMENTS

Not Used

DIVISION 33 – UTILITIES

Not Used

END OF SECTION

SECTION 00 0115 - LIST OF DRAWINGS

LIST OF DRAWINGS

1.01 GENERAL

A. Drawings: Drawings consist of the Contract Drawings including drawings listed on the TITLE SHEET page of the separately bound drawing sets titled DISTRICT ADMINISTRATION BUILDING, dated 06-23-2025 and any subsequent Addenda and Contract modifications which may occur.

END OF SECTION

SECTION 00 8200.02 - TMP ELECTRONIC FILES RELEASE FORM (FREE)

RE: AUTHORIZATION FORM FOR CAD FILE TRANSFERS
PROJECT NAME: TROY HIGH SCHOOL KITCHEN RENOVATION TMP 22104G

Dear Sir/Madam:

Per your request, TMP Architecture, Inc. will electronically transmit requested CAD files upon receipt of an original signed copy of this form which states the conditions of agreement and the receipt of the required compensation fee.

1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
2. It is further understood and agreed that the undersigned will hold TMP Architecture, Inc. and its Consultants harmless and indemnify TMP Architecture, Inc. and its Consultants from all claims, liabilities, losses, and so forth, including attorney's fees arising out of the use or misuse of the transferred files.
3. It is understood and agreed that the items transmitted are prepared from CAD files current at the time of preparation. All files are [AutoCAD version 2014 dwg files].
4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
5. As a record of information to be transmitted, TMP Architecture, Inc. will prepare a duplicate electronic back-up for its record.
6. Compensation for providing this material will be as follows: **$0.00 / No Charge**
7. A signed copy of this form must be provided before files will be released. Please remit to [Construction Manager] to be forwarded to the Project Manager at TMP Architecture, Inc. and allow five working days for processing.
8. A composite plan or "base" file of plan or site will be provided. Vertical views (elevations, sections, etc) will **NOT** be provided. General Information sheets will not be provided.
9. Requests that do not list specific drawing sheets or provide information regarding the use of the requested sheets may be rejected at the discretion of the Architect.

REQUESTED DRAWINGS: _____

_____

_____

FIRM REQUESTING FILES:

Company: _____
Address: _____
Signed:_____Date: _____
Printed Name / Title: _____
Email: _____

TO BE COMPLETED BY TMP ARCHITECTURE, INC.

Released(signed by): _____TMP Architecture, Inc.
Printed Name/Title:_____ Date: _____

END OF SECTION

SECTION 00 8200 - AVAILABILITY OF ELECTRONIC FILES

AVAILABILITY OF ELECTRONIC FILES

1.01 POLICY

A. As a service to Contractor, subcontractors, vendors, material suppliers and others needing electronic copies of Drawings, the Architect will provide CAD files electronically in accordance with the following policy:

1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
2. It is further understood and agreed that the undersigned will hold TMP Architecture, Inc. and its Consultants harmless and indemnify TMP Architecture, Inc. and its Consultants from all claims, liabilities, losses, and so forth, including attorney's fees arising out of the use or misuse of the transferred files.
3. It is understood and agreed that the files transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD version 2014 dwg files.
4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
5. As a record of information to be transmitted, TMP Architecture, Inc. will prepare a duplicate electronic back-up for its record.
6. Compensation Fee for providing this material will be as follows: $0.00 / No Charge.
7. A signed copy of the Release Form must be provided before files will be released.

1.02 REQUEST PROCEDURE

A. To receive Drawing CAD files the Release Form must be completed in full and submitted to the Construction Manager to be forwarded to the Project Manager at TMP Architecture, Inc.

1. A signed copy of the Release Form must be submitted.
   a. Faxed or emailed copies will be accepted.
2. Upon remittance of the signed Release Form , allow five working days for processing.
3. Transmission of Drawings will be provided electronically .

1.03 RELEASE FORM

A. Release Form is located immediately after this Section. Refer to Section 00 8200.02 Electronic Files Release Form.

END OF SECTION

SECTION 01 2200 - UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.02 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 MEASUREMENT OF QUANTITIES

A. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.

B. Assist by providing necessary equipment, workers, and survey personnel as required.

1.04 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

B. Payment will not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products remaining on hand after completion of the Work.

1.05 SCHEDULE OF UNIT PRICES

A. Unit Price 1 - Remedial Floor Coating

1. Description: Provide a unit cost for concrete slab remedial floor coating work as specified in Section 09 0561 Common Work Results for Flooring Preparation.
2. Unit of Measurement: Square Feet.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2300 - ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

1.02 ACCEPTANCE OF ALTERNATES

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

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

1.03 SCHEDULE OF ALTERNATES

A. Alternate 1 - Project 22106, Bid Package No. 5: New Exterior Doors

1. Base Bid: Do not install new exterior doors 152D and 154C. Do not provide and install exit signage associated with new doors.
2. Alternate: Provide and install new exterior doors 152D and 154C, associated storefront framing, and exit signage as documented.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2500.01 - TMP SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST NUMBER: _____ DATE SUBMITTED: _____
TMP PROJECT NUMBER _____PROJECT NAME: _____

SPECIFIED ITEM

SPECIFICATION TITLE:_____
SPECIFICATION SECTION_____SPECIFICATION ARTICLE/PARAGRAPH: _____
SPECIFIED PRODUCT / DESCRIPTION: _____
SPECIFIED MANUFACTURER: _____
SPECIFIED PRODUCT / MODEL: _____
REASON SPECIFIED ITEM CANNOT BE PROVIDED: _____
_____
_____

PROPOSED SUBSTITUTION

DESCRIPTION OF PROPOSED SUBSTITUTION: _____
_____
PROPOSED MANUFACTURER: _____
ADDRESS: _____
WEBSITE: _____
PRODUCT / MODEL: _____
YEARS PRODUCT/MODEL HAS BEEN MANUFACTURED: _____
DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED ITEM: _____
_____
_____
_____
_____
WILL PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK? ☐ NO ☐ YES
IF YES, EXPLAIN HOW: _____
_____
_____
_____
HOW WILL SUBSTITUTION BENEFIT THE OWNER: ☐ COST SAVINGS ☐ TIME SAVINGS ☐ OTHER
PROVIDE SPECIFIC DETAILS: _____
_____
_____
_____

THE FOLLOWING INFORMATION IS REQUIRED; CHECK TO INDICATE INFORMATION IS ATTACHED. (REQUEST WILL BE REJECTED WITHOUT REQUIRED DATA)

32.01

A. ☐ List of references where proposed product has been installed; include address, owner, architect, and date installed.
B. ☐ Product data sheets.
C. ☐ Applicable certificates and test reports.

D. ☐ Comparative Data: Provide point-by-point, side-by-side comparison of specified product and proposed substitution addressing essential attributes specified.

INDICATE WHICH OF THE FOLLOWING VOLUNTARY INFORMATION IS ATTACHED, IF ANY:
☐ DRAWINGS.
☐ SAMPLES.
☐ OTHER ITEMS: _____

SIGNATURE

THE UNDERSIGNED CERTIFIES:

The proposed substitution meets or exceeds the quality level of the specified product, equipment, assembly, or system.
To provide the same warranty for the substitution as for the specified product.
Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
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.
The proposed substitution will have no adverse effects on other work.
The proposed substitution will not affect project schedule.
Waives claims for additional costs or time extension that may subsequently become apparent.

CONTRACTOR / COMPANY: _____
SIGNED BY: _____PRINTED NAME: _____
TITLE: _____
ADDRESS: _____
EMAIL: _____ PHONE: _____

ARCHITECT'S RESPONSE

A. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.
B. During construction, Architect will notify Contractor in writing (see below) of decision to accept or reject request, and incorporate the substitution into the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments as provided for in the Conditions of the Contract.

☐ SUBSTITUTION APPROVED - PROVIDE SUBMITTALS PER SECTION 01 3000 AND RESPECTIVE SECTION FOR WHICH SUBSTITUTION WAS MADE.
☐ SUBSTITUTION REJECTED - PROVIDE SPECIFIED MATERIALS.

SIGNED BY: _____PRINTED NAME: _____
ARCHITECT'S COMMENTS: _____
_____
_____

END OF SECTION

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01 2500.01 - TMP Substitution Request Form.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

B. Substitutions: Any proposed substitution to be evaluated by the Architect and accepted as stipulated below.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms included in the Project Manual are adequate for this purpose, and must be used.

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

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:

B. Substitution Request Form: TMP Substitution Request Form must be completed and provided at the beginning of each substitution request.
   1. Refer to Section 01 2500.01 - TMP Substitution Request Form.
   2. Submittals without a completed TMP Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.

C. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Substitution Request Form: TMP Substitution Request Form must be completed and provided at the beginning of each substitution request.
   1. Refer to Section 01 2500.01 - TMP Substitution Request Form.
   2. Submittals without a completed TMP Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.

B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
   2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
   3. Bear the costs engendered by proposed substitution of:
      a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
      b. Other unanticipated project considerations.

D. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
   1. During construction, Architect's decision following review of proposed substitution will be noted on the submitted form.
   2. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION

SUBMITTAL AND SAMPLE TRANSMITTAL FORM

01 3000.01

CONST. MANAGER / CONTRACTOR	PROJECT	TMP PROJECT NO.	DATE SUBMITTED	SUBMITTAL NO.
Name and Address:	Title:	22106		
	District Administration Building Bid Package 5	* ACTION CODES		Initial Submittal ☐ Resubmittal ☐
Email:	Location:	R Reviewed – No Exceptions Taken RN Reviewed with Corrections Noted RR Revise and Resubmit X Not Approved – Resubmit NA No Action Taken – Not Reviewed		REVIEWED BY
Phone:	Troy School District 4400 Livernois Road Troy, Michigan 48098			TMP ☐ Consultant ☐ Reviewer:

SPECIFICATION SECTION NO.	SUBCONTRACTOR / MANUFACTURER	ITEM DESCRIPTION	NO. OF SAMPLES	NO. OF SAMPLES RETURNED	ACTION CODE *	DATE REVIEWED	DATE RETURNED
Transmittal shall be for one specification section only; do not submit items from multiple sections under the same transmittal. Multi-section submittals will be returned; stamped "X - Not Approved - Resubmit"							

Submittal Stamps may be placed on subsequent blank page.

CONTRACTOR COMMENTS	ARCHITECT COMMENTS	The undersigned certifies that the above submitted items have been reviewed in detail and are correct and in strict conformance with the Contract Documents except as otherwise noted. NOTE: Approval of items submitted does not relieve Contractor from complying with all requirements of the Contract Documents.
		CONTRACTOR NAME
		SIGNATURE

This page intentionally left blank for Submittal Stamps

SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals for review, information, and project closeout.
B. Number of copies of submittals.
C. Requests for Interpretation (RFI) procedures.
D. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 3000.01 - TMP Submittal and Sample Transmittal Form.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information; 2004.
B. CSI/CSC Form 13.2A - Request for Information; Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.
B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
      b. Do not forward requests which solely require internal coordination between subcontractors.
   2. Prepare in a format and with content acceptable to Architect. Use one of the following:
      a. Use AIA G716 - Request for Information .
      b. Use CSI/CSC Form 13.2A - Request for Interpretation.
      c. Other format acceptable to Architect.
   3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
   4. Submit RFIs through Procore, email, or other approved method agreed to by the Architect and Owner.
      a. RFIs submitted via an internet-based submittal service are to send electronic documents to the Architect via email with a downloadable link.
C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is 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. Improper RFIs: Requests not prepared in conformance to requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response and may include an explanatory notation.
   3. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response and may include 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.

D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Discrete and consecutive RFI number, and descriptive subject/title.
3. Issue date, and requested reply date.
4. 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).
5. Annotations: Field dimensions and/or description of conditions which have engendered the request.
6. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

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

F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Identify and include improper or frivolous RFIs.

G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 3:00 PM 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.

H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. 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.

3.02 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
1. Submit at the same time as the preliminary schedule.
2. Coordinate with Contractor's construction schedule and schedule of values.
3. Format schedule to allow tracking of status of submittals throughout duration of construction.

4. Arrange information to include scheduled date for initial submittal, specification number and title, description of item of work covered, and role and name of subcontractor.
5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
    a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.03 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.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.04 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 indicated.

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

3.05 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.06 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy.

B. Samples: Submit the number specified in individual specification sections, but not less than 3; one (minimum) 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.

3.07 SUBMITTAL PROCEDURES

A. Transmittal Form: TMP Submittal and Sample Transmittal Form must be completed and provided at the beginning of each submittal.
1. Refer to Section 01 3000.01 - TMP Submittal and Sample Transmittal Form.

2. Submittals without a completed TMP Submittal and Sample Transmittal Form will not be acknowledged, reviewed, or returned.

B. Submittals shall be submitted in electronic form.
   1. Exceptions: Physical samples.
      a. Physical Samples must be accompanied by an electronic copy and a hard/physical copy of the completed TMP Submittal and Sample Transmittal Form.

C. Electronic Submittals: Comply with the following:
   1. Submittal process shall be through Procore, email, or other approved method agreed to by the Architect and Owner.
      a. Submittals via an internet-based submittal service are to send electronic documents to the Architect via email with a downloadable link.
   2. File Format: Portable Document Format (PDF).
   3. File Naming: File naming shall be in the following format:
      a. Specification section number, followed by a hyphen, and a consecutive number indicating sequential submittals for that section; followed by a general description of the submittal contents.
         1) Examples:
            (a) Section 07 9200; first submittal:
               (1) 07 9200-01 Joint Sealants
            (b) Section 07 9200; second submittal:
               (1) 07 9200-02 Joint Sealant Color
      b. Resubmittals. For revised resubmittals use original number and a sequential combination numerical and alphabetical suffix; hyphen followed by "R" and a two-digit consecutive number indicating sequential resubmittals for that particular submittal.
         1) Examples:
            (a) Section 07 9200; resubmittal of first submittal of section:
               (1) 07 9200-01-R01 Joint Sealants.
            (b) Section 07 9200; second resubmittal of first submittal of section:
               (1) 07 9200-01-R02 Joint Sealants
            (c) Section 07 9200; first resubmittal of second submittal of section:
               (1) 07 9200-02-R01 Joint Sealant Color
   4. Each Submittal shall be one file, complete with all attachments.
      a. Multi-file submittal will not be acknowledged, reviewed, or returned.

D. General Requirements:
   1. Use a single transmittal for related items.
      a. Each transmittal shall be for one specification section only; do not submit items for multiple sections under the same transmittal.
         1) Multi-section submittals will be acknowledged and returned; stamped "X - Not Approved - Resubmit".
   2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   3. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   4. 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.
   5. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 14 calendar days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 calendardays.

6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
7. When revised for resubmission, identify all changes made since previous submission.
8. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
9. 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.
10. Submittals not requested will be recognized and returned; stamped "NA - No Action Taken - Not Reviewed"

E. 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 unless specifically called for in individual sections.

F. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
4. Non-complying submittals will be acknowledged and returned; stamped "X - Not Approved - Resubmit".

G. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Submit actual physical samples.
4. Electronic submittals will not be accepted unless prior approval is received from the Architect. Electronic samples without prior approval will be acknowledged and returned; stamped "X - Not Approved - Resubmit."

3.08 SUBMITTAL REVIEW

A. General: Submittals that do not conform to the requirements of this section will not be acknowledged, reviewed, or returned.

B. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

C. Submittals for Information: Architect will acknowledge and may review. See below for actions to be taken.

D. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Where more than one action has been indicated, each shall apply to that portion of the submittal for which the action is indicated.

E. Architect's review shall not indicate approval of dimensions, quantities or fabrication processes unless specific notations are made by the Architect regarding same.

F. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
a. "Reviewed - No Exceptions Taken", "Approved", or language with same legal meaning.
b. "Reviewed with Corrections Noted", "Approved as Noted, Resubmission not required", or language with same legal meaning.
1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.

2. Not Authorizing fabrication, delivery, and installation:
   a. "Revise and Resubmit", "Not Approved - Resubmit", or language with the same legal meaning.
      1) Resubmit revised item, with review notations acknowledged and incorporated.
3. Not Authorizing manufacturer:
   a. Rejected - Resubmit, or language with the same legal meaning.

G. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
   a. "No Action Taken - Not Reviewed" or "Received" - to notify the Contractor that the submittal has been received for record only.

END OF SECTION

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.
B. Quality assurance.
C. References and standards.
D. Testing and inspection agencies and services.
E. Contractor's design-related professional design services.
F. Control of installation.
G. Mock-ups.
H. Tolerances.
I. Manufacturers' field services.
J. Defect Assessment.

1.02 REFERENCE STANDARDS

A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
B. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
C. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.

1.03 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. 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, appropriately licensed design professional.

1.04 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
B. Base design on performance and/or design criteria indicated in individual specification sections.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
    1. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
    2. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
C. Test Reports: After each test/inspection, promptly submit 1 copies of report to Architect and to Contractor.
    1. Include:

a. Date issued.
b. Project title and number.
c. Name of inspector.
d. Date and time of sampling or inspection.
e. Identification of product and specifications section.
f. Location in the Project.
g. Type of test/inspection.
h. Date of test/inspection.
i. Results of test/inspection.
j. Compliance with Contract Documents.
k. When requested by Architect, provide interpretation of results.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications:
1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time specialist and responsible officer.

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

1.07 REFERENCES AND STANDARDS

A. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

B. Obtain copies of standards where required by product specification sections.

C. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.08 TESTING AND INSPECTION AGENCIES AND SERVICES

A. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

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

C. Contractor Employed Agency:

1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, and ASTM E699.
2. Inspection agency: Comply with requirements of ASTM E329.
3. Laboratory Staff: Maintain a full time specialist on staff to review services.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

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

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
D. Notify Architect 5 working days in advance of dates and times when mock-ups will be constructed.
E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Make corrections as necessary until Architect's approval is issued.
I. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.
B. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.
C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.
D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 48 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

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

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.

END OF SECTION

SECTION 01 4100 - REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY OF REFERENCE STANDARDS

A. Regulatory requirements applicable to this project are the following:
   1. ASHRAE Std 90.1 I-P-2019 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2019, with Errata and Addenda (2021).
   2. Barrier Free Code: Comply with the following:
      a. Michigan Building Code; 2021.
      b. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
   3. Building Code: Michigan Building Code; 2021.
   4. Plumbing Code: Michigan Plumbing Code; 2021.
   5. Mechanical Code: Michigan Mechanical Code; 2021.
   6. Electrical Code: NFPA 70 - National Electric Code; 2023.
      a. Includes 2023 Michigan Construction Code - Part 8 Electrical Code Rules.
   7. Elevator Code: Comply with the following:
      a. ASME A17.1 - Safety Code for Elevators and Escalators; 2016.
      b. ASME A18.1- Safety Standard for Platform Lifts and Stairway Chairlifts; 2017.
      c. 2023 Michigan Elevator Safety Board General Rules.
   8. Boiler Code: Michigan Boiler Code.
      a. Includes the following:
         1) ASME Boiler and Pressure Vessel Codes; 2019.
         2) National Board Inspection Code; 2019.
         3) PA 407 Skilled Trades Regulation Act; 2016.
   9. Energy Code: Michigan Commercial Energy Code; 2021.
      a. Includes ASHRAE Std 90.1 I-P-2019 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2019.
   10. Existing Building Code: Michigan Rehabilitation Code; 2021.

B. Where specification sections reference more current standards or codes, comply with the more restrictive requirements unless notified in writing by Architect.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 4216 - DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

A. This section supplements the definitions contained in the General Conditions.

B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

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

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

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

D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.

E. Provide: To furnish and install.

F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 4219 - REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements relating to referenced standards.

1.02 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 specified in this section, 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.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION -- NOT USED

END OF SECTION

SECTION 01 4533 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Code-required special inspections.
B. Submittals.

1.02 ABBREVIATIONS AND ACRONYMS

A. AHJ: Authority having jurisdiction.
B. NIST: National Institute of Standards and Technology.

1.03 DEFINITIONS

A. Code or Building Code: Michigan Building Code; 2015, 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.
C. Special Inspection:
   1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.
   2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.04 REFERENCE STANDARDS

A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
   1. Submit agency name, address, and telephone number, names of full time specialist and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Special Inspection Agency is acceptable to AHJ.
C. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to the 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.

D. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator's facility, Special Inspector is required to promptly 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 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 standard(s).

E. Test Reports: After each test or inspection, promptly 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 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.

1.06 SPECIAL INSPECTION AGENCY

A. Owner will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.

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

1.07 QUALITY ASSURANCE

A. Special Inspection Agency Qualifications:
   1. Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
   1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
   2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS

A. Special inspections and testing shall be for materials, installation, fabrication, erection or placement of components and connections as indicated on Drawings, but not less than that required by the building code.

END OF SECTION

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 SUBMITTALS

A. 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.
B. 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.
C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
    1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
D. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.
    1. Refer to Drawings and Section 02 4100 - Demolition.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

2.03 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. Available Products: Products specified by naming one or more Manufacturers as an Available Product indicates that these Manufacturers' products may be provided but other comparable products and Manufacturers not named may also be provided without submitting a request for substitution.

2.04 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

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:

1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
2. Arrange and pay for product delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:

1. Review Owner reviewed shop drawings, product data, and samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

G. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide off-site storage and protection when site does not permit on-site storage or protection.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Do not store products directly on the ground.
J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
L. Prevent contact with material that may cause corrosion, discoloration, or staining.
M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
N. 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 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition.
C. Pre-installation meetings.
D. Cutting and patching.
E. Surveying for laying out the work.
F. Cleaning and protection.
G. Starting of systems and equipment.
H. Demonstration and instruction of Owner personnel.
I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
J. General requirements for maintenance service.

1.02 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

1.03 SUBMITTALS

A. See Section 01 3000 - 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. Effect on work of Owner or separate Contractor.
C. Project Record Documents: Accurately record actual locations of capped and active utilities.
D. Warranties: For each affected material under warranty, submit written verification, signed by manufacturer of existing materials, stating that the Owner's full warranty will remain in effect after cutting and patching operations have been completed

1.04 QUALIFICATIONS

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

1.05 PROJECT CONDITIONS

A. Use of explosives is not permitted.
B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
D. Perform dewatering activities, as required, for the duration of the project.

E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
F. Dust 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.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
   2. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.
I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

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.

1.07 WARRANTIES

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
B. Require attendance of parties directly affecting, or affected by, work of the specific section.
C. Notify Architect 5 calendar days in advance of meeting date.
D. Prepare agenda and preside at meeting:
    1. Review conditions of examination, preparation and installation procedures.
    2. Review coordination with related work.
E. Record minutes and distribute copies within two days after meeting to participants, with 1 copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Contractor shall locate and protect survey control and reference points.
D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
G. Utilize recognized engineering survey practices.
H. 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.
4. Controlling lines and levels required for mechanical and electrical trades.

I. Periodically verify layouts by same means.

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

3.05 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.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation only.
1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
2. Relocate items indicated on drawings.
3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
b. Provide temporary connections as required to maintain existing systems in service.

4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. 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.

D. 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.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
      a. This includes painted surfaces.
      b. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
   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.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architectand Owner 7 calendar days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

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

3.12 ADJUSTING

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

3.13 FINAL CLEANING

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

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
B. Accompany Contractor on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
D. 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.
E. 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.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
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 the Owner.

END OF SECTION

SECTION 01 7327 - CUTTING AND PATCHING OF SINGLE PLY ROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes procedural requirements for cutting and patching.
   1. Related Sections include the following:
      a. Divisions 2 through 28 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.02 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.03 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
   1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
   2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
   3. Products: List products to be used and firms or entities that will perform the Work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
   6. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
   1. If possible, retain original Installer to cut and patch exposed Work listed below:
      a. EPDM Single Ply Membrane Roofing
      b. TPO Single Ply Membrane Roofing

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.04 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
   1. Existing Roof: The existing roof is a roof system which is still under warranty. Comply with the following requirements when modifying the existing roof and adding new penetrations:
      a. Notify original roof manufacturer prior to beginning any work and comply with all manufacturer guidelines and requirements.

b. Provide original roof manufacturer with a brief description of the proposed work, including any required submittals.
c. Work shall not begin until written approval is received from original roof manufacturer.
d. Work must be done by an approved manufacturer's contractor.
e. Original roof manufacturer shall inspect all modifications to the original roof system.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.
B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.
B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

3.03 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. Review proposed procedures with original Roof Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Proceed with patching after construction operations requiring cutting are complete.

3.04 ROOF FLASHING INSTALLATION AROUND NEW PENETRATIONS

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing as recommended by manufacturer.
D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.
F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
    1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
    2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.

END OF SECTION

SECTION 01 7329 - CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cutting and patching.

1.02 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.03 SUBMITTALS

A. See Section 01 3000 - 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. Location and description of affected work.
   b. Necessity for cutting or alteration.
   c. Description of proposed work and products to be used.
   d. Effect on work of Owner or separate Contractor.

C. Warranties: For each affected material under warranty, submit written verification, signed by manufacturer of existing materials, stating that the Owner's full warranty will remain in effect after cutting and patching operations have been completed.

1.04 WARRANTIES

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

1. Materials that are still under warranty include, but are not limited to, the following:
   a. Single-Ply Membrane Roofing.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. 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.

B. Prior to Patching: Before patching, verify compatibility and suitability of substrates, including compatibility with existing finishes or primers. Beginning of patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.
D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
E. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.03 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-conforming work.
C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
D. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
E. Cutting:
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces.
   2. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
   3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
F. Restore work with new products in accordance with requirements of Contract Documents.
G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400 - Firestopping, to full thickness of the penetrated element.
I. Patching:
   1. Repair adjacent construction and finishes damaged during removal work and cutting work.
   2. 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.
      a. This includes painted surfaces.
      b. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
   3. Match color, texture, and appearance.
   4. 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.

END OF SECTION

SECTION 01 7800 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
B. 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.
C. 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

3.01 PROJECT RECORD DOCUMENTS

A. General:
   1. Project Record Documents include:
      a. Complete set of Record Drawings.
      b. Complete set of Record Submittals.
      c. Complete set of Specifications.
   2. Project Record Documents shall be submitted in electronic form.
      a. File Format: Portable Document Format (PDF).
      b. Files shall be named and organized in a searchable, easy to understand, system.
   3. Ensure entries are complete and accurate, enabling future reference by Owner.
   4. Record information concurrent with construction progress.
B. Record Drawings: Record Drawings shall include the following:
   1. Complete set of Drawings.
      a. Indicate and record actual construction including, but not limited to, the following:
         1) Show all systems and assemblies as they exist at completion of the Work.
         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.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.

C. Record Submittals: Record Submittals shall include the following:
   1. Complete set of Submittals, including resubmittals.
   2. Shop Drawings shall indicate all field changes and other variations from the Submittal as originally reviewed by Architect.
D. Specifications: Specifications shall include the following:
   1. Complete Project Manual including all specifications, front end material, reports, and information available to bidders, as originally bid.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.

3.02 OPERATION AND MAINTENANCE DATA

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

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
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.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.
B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
D. Include color coded wiring diagrams as installed.
E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
G. Provide servicing and lubrication schedule, and list of lubricants required.
H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.
J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
K. Provide control diagrams by controls manufacturer as installed.
L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
M. Include test and balancing reports.
N. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. General:
   1. Operational and Maintenance Manuals include:
      a. Operational and maintenance data.
      b. Operational and maintenance data for materials and finishes.
      c. Operational and maintenance data for equipment and systems.
   2. Operational and Maintenance Manuals shall be submitted both in electronic form and as hard copy/durable manuals.
      a. Subject to Owner approval, hard copy/durable manuals may be omitted.
      b. Electronic File Format: Portable Document Format (PDF).
         1) Files shall be named and organized in a searchable, easy to understand, system similar to the descriptions for the hard copy/durable manuals
B. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
C. Where systems involve more than one specification section, provide separate tabbed divider for each system.
D. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
E. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
F. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
G. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
H. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
I. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
J. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
K. 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. Operation and maintenance data.
      c. Field quality control data.
      d. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 02 4100 - DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.
B. Selective demolition of building elements for alteration purposes.
C. Abandonment and removal of existing utilities and utility structures.
D. Salvaged items.
E. Removed and reinstalled items.

1.02 RELATED REQUIREMENTS

A. Section 04 2000 - Unit Masonry: Salvaging existing brick.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.
B. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
    1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of existing building as indicated on Drawings including, but not limited to, the following:
    1. Remove concrete slabs on grade as indicated on drawings.
    2. Remove other items indicated, for salvage and relocation.
    3. Remove and dispose of items as indicated on drawings.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with other requirements specified in Section 01 7000.
B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
    1. Obtain required permits.
    2. Comply with applicable requirements of NFPA 241.
    3. Prior to start of demolition operations, perform an engineering survey of building condition to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures.
    4. Use of explosives is not permitted.
    5. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
    6. Provide, erect, and maintain temporary barriers and security devices.
    7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
    8. Do not close or obstruct roadways or sidewalks without permit.
    9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Do not begin removal until built elements to be salvaged or relocated have been removed.

E. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, PCB's, and mercury.

H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
   1. Where concrete cannot be cut full depth, cut concrete to a depth of at least 3/4 inch. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
   1. Refer to Section 04 2000 - Unit Masonry for salvaging brick.

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 according to recommendations in RFCI (RWP). Do not use methods requiring solvent-based adhesive strippers.

E. Carpet: Remove carpet and adhesive according to industry standard and below. Do not use methods requiring solvent-based adhesive strippers.
   1. Remove carpet in managable sections and dispose.
   2. Using a floor scraper, scrape residual of carpet and adhesive from concrete.
   3. Sand the floor by mechanical means starting with a heavy grit to remove the bulk of the left adhesive and then a finer grit (approx 300) for the finish sand to allow new finish to be applied.

3.04 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.05 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
B. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction as specified and/or indicated on Drawings .
C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on Drawings.
E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.06 SALVAGED ITEMS

A. Clean salvaged items.
B. Pack or crate items after cleaning. Identify contents of containers.
C. Store items in a secure area until delivery to Owner.
D. Transport items to Owner's storage area on-site.
E. Protect items from damage during transport and storage.

3.07 REMOVED AND REINSTALLED ITEMS

A. Clean and repair items to functional condition adequate for intended reuse.
B. Pack or crate items after cleaning and repairing. Identify contents of containers.
C. Protect items from damage during transport and storage.
D. 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.

3.08 EXISTING ITEMS TO REMAIN

A. Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete

3.09 DEBRIS AND WASTE REMOVAL

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

END OF SECTION

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.
B. Elevated concrete slabs.
C. Floors and slabs on grade.
D. Concrete foundation walls.
E. Concrete reinforcement.
F. Joint devices associated with concrete work.
G. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, and other items as indicated on Drawings.
H. Concrete curing.
I. Products installed under this section:
    1. Manufactured reglets cast in concrete; furnished by Section 07 6200 - Sheet Metal Flashing and Trim.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
B. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
C. ACI 301 - Specifications for Concrete Construction; 2020.
D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
E. ACI 308R - Guide to External Curing of Concrete; 2016.
F. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
G. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
H. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
J. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.
K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2019a.
L. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
M. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
N. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
O. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.
P. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2023.
Q. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
R. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
S. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

T. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
U. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
V. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
W. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.
X. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).
Y. ASTM D8139 - Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction; 2023.
Z. 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.
AA. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
BB. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
CC. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
C. Mix Design: Submit proposed concrete mix designs.
    1. Indicate where each mix design will be used.
D. Samples: Submit samples of underslab vapor retarder to be used.
E. Concrete jointing plan, if not indicated on Drawings.
F. Test Reports: Submit report for each test or series of tests specified.
G. Field Quality Control Reports: Provide the following:
    1. F(F) Floor Flatness and F(L) Floor Levelness measurements as specified.
H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Slabs with Moisture Vapor Reducing Admixture (MVRA): Provide warranty to cover the cost of flooring failures due to moisture migration from slabs for life of the concrete.
    1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.
C. Stained and Polished Finish Systems:
    1. Provide 10 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.
B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
2. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
   a. Composition: Water-based, reactive, natural organic chemicals.
   b. VOC Content: None; water-based.
   c. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      1) SpecChem, LLC; Bio Strip WB: www.specchemllc.com.
      2) The Euclid Chemical Company; Formshield WB: www.euclidchemical.com.
      3) W. R. Meadows, Inc; Duogard II: www.wrmeadows.com.
3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.
B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
   1. Form: Flat Sheets.
   2. WWR Style: As indicated on drawings.
C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type. Provide _____ manufactured by _____ .
B. Fine and Coarse Aggregates: ASTM C33/C33M.
C. Fly Ash: ASTM C618, Class C or F.
D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
B. Air Entrainment Admixture: ASTM C260/C260M.
C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
E. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
F. Retarding Admixture: ASTM C494/C494M Type B.
G. Water Reducing Admixture: ASTM C494/C494M Type A.
H. Moisture Vapor Reduction Admixture (MVRA): ASTM C494/C494M, Type S; liquid, inorganic admixture free of volatile organic compounds (VOCs) and formulated to permanently close capillary systems formed during curing to reduce moisture vapor emission and transmission with no adverse effect on concrete properties or finish flooring.
   1. Products:
      a. Barrier One, Inc; CPS Admix - Moisture Vapor Reduction Admixture (MVRA): www.barrierone.com.
      b. ISE Logik Industries, Inc; MVRA 900: www.iselogik.com.

c. Specialty Products Group; Vapor Lock 20/20: www.spggogreen.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder:
1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
2. Minimum Thickness: 15 mil.
3. Products:
a. Fortifiber Building Systems Group: www.fortifiber.com.
b. Inteplast Group; Barrier-Bac VB-350: www.barrierbac.com.
c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com.
d. Poly-America; Husky Yellow Guard 15-mil Vapor Barrier: www.yellowguard.com.
e. Stego Industries, LLC; 15 mil: www.stegoindustries.com.
f. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com.
g. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
1. Grout: Comply with ASTM C1107/C1107M.
2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.
4. Low-Slump, Dry Pack Products:
a. Euclid Chemical Company; DRY PACK GROUT: www.euclidchemical.com/#sle.
b. Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
c. Substitutions: See Section 01 6000 - Product Requirements.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.

B. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
1. Configuration: As indicated on drawings.
2. Size: As indicated on drawings.

C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
1. Material: ASTM D1751, cellulose fiber.
2. Material: ASTM D1752, recycled PVC (Type IV).
3. Material: ASTM D8139, semi-rigid, closed-cell polypropylene foam.
4. Products:
a. Oscoda Plastics, Inc; Proflex Vinyl Expansion Joints: www.oscodaplastics.com.
b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
c. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

D. Dowel Sleeves: Plastic sleeve for smooth, round, steel load-transfer dowels.

2.07 CURING MATERIALS

A. Moisture-Retaining Sheet: ASTM C171.
1. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
2. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

B. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
   1. Provide moisture vapor reduction admixture in slabs to receive adhesively applied flooring.

C. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch.
   2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
   3. Cement Content: Minimum 470 pounds per cubic yard.
   4. Water-Cement Ratio: Maximum 45 percent by weight.
   5. Total Air Content: Determined in accordance with ASTM C173/C173M.
      a. Concrete exposed to freeze thaw cycle: 6 percent, plus or minus 1 percent at point of delivery.
      b. Hard troweled interior concrete: Do not exceed 3 percent.
   6. Maximum Slump: 4 inches (without admixtures).
   7. Maximum Aggregate Size: 1 inch.

D. Concrete mix design requirements for concrete floor slabs to be stained and polished as specified in Section 03 3511 - Concrete Floor Finishes.
   1. Aggregates: Uniformly graded mix of not less than 3 aggregate sizes; fine, intermediate and large.
   2. Admixtures: Less than 1 to 2 percent of total mix weight.
   3. Materials replacing portions of portland cement shall not exceed 10 percent of the portland cement volume and should not be calcium chloride based. Includes, but is not limited to, the following:
      a. Plasticizers.
      b. Slag
      c. Fly ash.
   4. Compressive Strength: 4,000 psi, minimum, at 28 days.
   5. Water-Cement Ratio: Maximum 45 percent by weight.

2.09 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use latex bonding agent only for non-load-bearing applications.

E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

3.04 CONCRETE REQUIREMENTS AT HARD TILE FLOOR FINISHES

A. Hard tile specified in Section 09 3000 - Hard Tiling shall be installed on concrete floor slabs without control joints and slab jointing.

B. Unless more stringent requirements are indicated, provide the following minimum requirements at concrete floor slabs where hard tile finishes shall be installed:

1. Concrete Floor Slab Thickness: 5 inches.
2. Reinforcement: No. 4 reinforcing steel (rebars) at 12 inches on center each way.
   a. Fiber reinforcement is not permitted.
3. Control Joints and Slab Jointing: None permitted.

3.05 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

D. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.06 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:

1. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.

D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

E. Exterior concrete platforms, steps, and ramps, and elsewhere as indicated shall have broom finish.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

F. Concrete polishing and staining See Section 03 3511.

G. Concrete liquid densifier/hardener: See Section 03 3511 - Concrete Floor Finishes.

3.07 CURING AND PROTECTION

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

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
B. Provide free access to concrete operations at project site and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

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

END OF SECTION

SECTION 03 3003 - CAST-IN-PLACE CONCRETE REQUIREMENTS FOR FLOOR SLABS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Underslab vapor retarder.
B. Reinforcing and jointing requirements for cast-in-place concrete floor slabs receiving hard tile floor finishes.
C. Floor flatness and levelness tolerances; slabs on grade and suspended slabs.
D. Concrete curing requirements for concrete stain and polished finish systems.
E. Liquid densifier/hardener.

1.02 REFERENCE STANDARDS

A. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).
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 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.
D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
E. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.
F. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of floor slab installation and the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
C. Mix Design: Submit proposed concrete mix design.
D. Field Quality Control Reports: Provide the following:
    1. F(F) Floor Flatness and F(L) Floor Levelness measurements as specified.
E. Submit documentation from manufacturers certifying that curing products and methods are compatible with concrete staining and polishing materials and methods.
F. Manufacturer's Qualification Statement.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience.
B. Obtain moisture vapor reduction admixture from a single manufacturer.
C. In addition to requirements of this Section comply with requirements of Section 03 3000 - Cast-in-Place Concrete.
    1. If there is a conflict between sections, comply with the more stringent requirement unless otherwise indicated by Architect.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 UNDERSLAB VAPOR RETARDER

A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; 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. Installation: Comply with ASTM E1643.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
   3. Minimum Thickness: 15 mil.
   4. Products:
      a. Fortifiber Building Systems Group: www.fortifiber.com.
      b. Inteplast Group; Barrier-Bac VB-350: www.barrierbac.com.
      c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com.
      d. Poly-America; Husky Yellow Guard 15-mil Vapor Barrier: www.yellowguard.com.
      e. Stego Industries, LLC; 15 mil: www.stegoindustries.com.
      f. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils: www.wrmeadows.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CONCRETE MIX DESIGN

A. General: Comply with requirements of Section 03 3000 - Cast-in-Place Concrete and as follows.

2.03 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 3000 - Cast-in-Place Concrete.

2.04 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
   1. Composition: Sodium silicate.
   2. Products:
      a. Dayton Superior Corporation; Densifier J13: www.daytonsuperior.com.
      b. Euclid Chemical Company; EUCO DIAMOND HARD: www.euclidchemical.com.
      c. Kaufman Products Inc; SureHard: www.kaufmanproducts.net.
      d. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; SEAL HARD: www.lmcc.com.
      e. W. R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.
   3. Locations:
      a. Use at following locations: Unless otherwise indicated, unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs are to be finished using liquid densifier/hardener.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. In addition to requirements of this Section comply with requirements of Section 03 3000 - Cast-in-Place Concrete.

3.02 UNDERSLAB VAPOR RETARDER

A. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings.

3.03 CONCRETE REQUIREMENTS AT HARD TILE FLOOR FINISHES

A. Hard tile specified in Section 09 3000 - Hard Tiling shall be installed on concrete floor slabs without control joints and slab jointing.

B. Unless more stringent requirements are indicated, provide the following minimum requirements at concrete floor slabs where hard tile finishes shall be installed:
   1. Concrete Floor Slab Thickness: 5 inches.
   2. Reinforcement: No. 4 reinforcing steel (rebars) at 12 inches on center each way.
      a. Fiber reinforcement is not permitted.

C. Control Joints and Slab Jointing: None permitted.

3.04 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. General: Unless more stringent requirements are indicated or specified in Section 03 3000 - Cast-in-Place Concrete, comply with floor flatness and levelness values specified in this section.

B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
   1. Exposed to View and Foot Traffic: F(F) of 25; F(L) of 20, on-grade only.
   2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
   3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
   4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
   5. Under Wood Gymnasium Floors and Stage Floors: F(F) of 50.
      a. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/8 inch in 10 feet.
   6. Stained and Polished Concrete Floors: F(F) of 50; F(L) of 30, on-grade only.

C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.05 CONCRETE CURING REQUIREMENTS

A. At Slabs for Stained and Polished Concrete Floors: Cure with evaporation control and wet curing methods.
   1. Chemically reactive curing agents, membrane curing agents, and other topically applied curing compounds are not permitted.

3.06 LIQUID DENSIFIER/HARDENER

A. Apply liquid densifier/hardener in accordance with manufacturer's instructions.

B. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

C. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by liquid densifier/hardener manufacturer according to ASTM D4263 and ASTM F2170.

D. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

3.07 FIELD QUALITY CONTROL

A. Slab Testing: Cooperate with manufacturer of specified moisture vapor reduction admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

END OF SECTION

SECTION 03 5400 - CAST UNDERLAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Liquid-applied self-leveling floor underlayment.
   1. Use cementitious type at locations indicated.

1.02 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
B. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
C. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2019.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cementitious Underlayment:
   1. ARDEX Engineered Cements; ARDEX K 15: www.ardexamericas.com.
   2. Custom Building Products; TechLevel 150 Self-Leveling Underlayment: www.custombuildingproducts.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
   1. Compressive Strength: Minimum 4000 pounds per square inch after 28 days, tested per ASTM C109/C109M.
   2. Flexural Strength: Minimum 1000 psi after 28 days, tested per ASTM C348.
   3. Final Set Time: 1-1/2 to 2 hours, maximum.
   4. Thickness: Capable of thicknesses from 1/8 inch to 1-1/2 inch without additional aggregate.
B. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/4 inch in size and acceptable to underlayment manufacturer.

C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
D. Primer: Manufacturer's recommended type.
E. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

2.03 MIXING

A. Site mix materials in accordance with manufacturer's instructions.
B. Add aggregate for areas where thickness will exceed 1-1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
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.

3.03 APPLICATION

A. Install underlayment in accordance with manufacturer's instructions.
B. Pump or pour material onto substrate. Do not retemper or add water.
    1. Pump, move, and screed while the material is still highly flowable.
    2. Be careful not to create cold joints.
    3. Wear spiked shoes while working in the wet material to avoid leaving marks.
C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft.
D. For final thickness over 1-1/2 inches, place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
E. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
F. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.04 CURING

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

3.05 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 0100 - MAINTENANCE OF MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water, Chemical, and Detergent cleaning of masonry surfaces.
B. Replacement of masonry units.
C. Repointing mortar joints.
D. Repair of damaged masonry.

1.02 RELATED REQUIREMENTS

A. Section 04 2000 - Unit Masonry: Brick masonry units.
B. Section 04 2000 - Unit Masonry: Mortar and grout.
C. Section 04 2000 - Unit Masonry: Salvaging existing brick.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
   1. Require attendance of parties directly affecting work of this section.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on cleaning materials, mortar materials, masonry materials, and accessory materials .
C. Quality Control Program: Provide for brick replacement and repointing work.
D. Restorer qualifications.

1.05 QUALITY ASSURANCE

A. Restorer: Company specializing in masonry restoration with minimum 5 years of documented experience.

1.06 MOCK-UP

A. Restore and repoint an existing masonry wall area sized 8 feet long by 8 feet high; include in mock-up area instances of mortar, accessories, and brick replacement.
B. Clean a 10 ft by 10 ft panel of wall to determine extent of cleaning.
   1. Mockups to include all cleaning methods proposed for use, including detergent cleaners, chemical cleaners, paint strippers, and biological cleaners.
C. Locate where directed.
D. Acceptable panel and procedures employed will become the standard for work of this section.
E. Mock-up may remain as part of the Work.
F. Do not begin Work until mock-ups are approved by Architect.

1.07 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 CLEANING MATERIALS

A. Water: Potable.
   1. Hot Water: Water heated to a temperature of 140 to 160 deg F.
B. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.
C. Nonacidic Cleaner: Manufacturer's standard mildly alkaline gel cleaner formulated for removing mold, mildew, and other organic soiling from natural stone and cast stone as well as brick.

1. Basis-of-Design: Sure Klean 942 Limestone & Marble Cleaner; Prosoco, Inc.

D. Mild-acid Cleaner: Manufacturer's standard mildly acidic cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.
   1. Basis-of-Design: Enviro Klean EK Restoration Cleaner; Prosoco, Inc.

E. Paint Stripper: Manufacturer's standard neutral-PH gel stripper compound formulated for removing alkyd, acrylic, and graffiti paints from masonry.
   1. Basis-of-Design: Enviro Klean SafStrip 8; Prosoco, Inc.

F. Biological Cleaner: Manufacturer's standard mildly acidic liquid cleaner for removing mold, mildew, and other biological soiling .
   1. Basis-of-Design: Enviro Klean Revive Prosoco, Inc.

2.03 MORTAR MATERIALS

A. Repointing Mortar: Type N.
   1. Conform to requirements of Section 04 2000 - Unit Masonry.
   2. Match existing mortar in color and texture.

2.04 MASONRY MATERIALS

A. Brick: Refer to Section 04 2000 - Unit Masonry.
   1. Reuse salvaged existing brick for restoration and repair work to maximum extent possible in all visible locations. Use new brick only when quantities of existing brick are insufficient.

2.05 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.
   1. Basis-of-Design: Sure Klean Strippable Masking; Prosoco, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces to be cleaned and restored are ready for work of this section.

3.02 PREPARATION AND PROTECTION

A. Protect surrounding elements from damage due to restoration procedures.

B. Carefully remove and store removable items located in areas to be restored, including fixtures, fittings, finish hardware, and accessories; reinstall upon completion.

C. Separate areas to be protected from restoration areas using means adequate to prevent damage.

D. Cover existing landscaping with tarpaulins or similar covers.

E. Mask immediately adjacent surfaces with material that will withstand cleaning and restoration procedures.
   1. When cleaning is completed, remove masking materials, leaving no residues that could trap dirt.

F. When using cleaning methods that involve water or other liquids, install drainage devices to prevent runoff over adjacent surfaces unless those surfaces are impervious to damage from runoff.

G. Do not allow cleaning runoff to drain into sanitary or storm sewers.

H. Neutralize alkaline and acid wastes before disposal.

I. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.

3.03 BRICK REMOVAL AND REPLACEMENT

A. Damaged Brick: Remove bricks that are damaged, cracked, spalled, or deteriorated. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

1. When removing single bricks, remove material from center of brick and work toward outside edges.
2. Cut out mortar by hand with chisel and mallet. Do not use power-operated grinders without Architect's written approval.
   a. Submit quality-control program and demonstrated ability of operators to use power tools without damaging masonry. Quality-control program shall include provisions for supervising performance and preventing damage due to worker fatigue.
   b. If Architect approves the use of small blade grinders, cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Do not use grinders on head joints. Remove remaining mortar by hand with chisel and mallet.
      1) Strictly adhere to written quality-control program.

B. Loose Brick: Remove bricks that are loose and no longer bonded with mortar in an undamaged condition.
   1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
   2. Store brick for reinstallation.

C. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose masonry units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Clean bricks surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.

F. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

G. Lay replacement brick and reinstalled loose brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks Use wetting methods that ensure that units are nearly saturated but surface is dry when laid. Maintain joint width for replacement units to match existing joints.
   1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
   2. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.

3.04 REPOINTING MASONRY

A. Rake out and repoint mortar joints to the following extent:
   1. All joints in areas indicated.
   2. Joints where mortar is missing or where they contain holes.
   3. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
   4. Cracked joints where cracks are 1/8 inch or more in width and of any depth.
   5. Joints that sound hollow when tapped by metal object.
   6. Joints that are worn back 1/4 inch or more from surface.
   7. Joints that are deteriorated to point that mortar can be easily removed by hand.
   8. Joints, other than those indicated as sealant-filled joints, that have been filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows:
   1. Remove mortar from joints to depth of 2-1/2 times joint width, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.

2. Remove mortar from brick and stone surfaces within raked-out joints to provide reveals with square backs and to expose brick and stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of brick or stone units or widen joints. Replace or patch damaged masonry units as directed by Architect.
4. Cut out mortar by hand with chisel and mallet. Do not use power-operated small blade grinders without Architect's written approval.
   a. Submit quality-control program and demonstrated ability of operators to use power tools without damaging masonry. Quality-control program shall include provisions for supervising performance and preventing damage due to worker fatigue.
   b. If Architect approves the use of small blade grinders cut out center of mortar bed joints using small blade angle grinders with diamond-impregnated metal blades. Do not use small blade grinders on head joints. Remove remaining mortar by hand with chisel and mallet.
      1) Strictly adhere to written quality-control program.
   c. If damage occurs using angle grinders then cut out mortar by hand with chisel and mallet.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Point brick joints as follows:
1. Rinse masonry-joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen masonry-joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing bricks or stone units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar over edges onto exposed brick or stone surfaces or to featheredge mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints. Remove excess mortar from edge of joint by brushing.

F. Refer to Section 07 9200 - Joint Sealants for sealing stone joints.

3.05 MORTAR CURING

A. Cure mortar by maintaining in thoroughly damp condition for at least 72 hours including weekends and holidays.

B. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.

C. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

3.06 MASONRY REPAIRS AND REPOINTING CLEANING - GENERAL

A. Immediately remove stains, efflorescence, or other excess resulting from brick replacement and repointing of masonry.

B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.
1. Clean surfaces and remove large particles with wood scrapers, brass or nylon wire brushes.

C. Clean surrounding surfaces.

3.07 CLEANING MASONRY - GENERAL

A. General: Begin with the mildest form of cleaning and proceed to harsher cleaning methods only after a milder method has not yielded the desired results. Subject to the substrate being cleaned, the cleaning methods from mildest to harshest are as follows:
   1. Detergent solution cleaning.
   2. Nonacidic chemical cleaning.
   3. Mild-acid chemical cleaning.
   4. Where above cleaning methods has proven not to completely remove paint or biological soiling in the mockups, use special paint strippers and biological cleaners to remove paint and biological soiling prior to cleaning methods indicated above.

B. Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 10 feet away, subject to Architect's approval.

C. Where brick replacement and repointing work precedes cleaning of existing brick and stone, allow mortar to fully set and cure.
   1. Allow mortar to harden at least 30 days before beginning cleaning work.

D. Preliminary Cleaning: Prior to applying cleaning materials complete the following:
   1. Brush loose soil and plant debris from open joints.
   2. Carefully remove plants, creepers, and vegetation.
   3. Remove extraneous substances including paint, calking, asphalt, and tar that are resistant to planned cleaning methods using scrappers.
      a. Do not scratch or chip masonry surfaces.

E. Proceed with cleaning in an orderly manner; work from bottom to top, and from one end of each elevation to the other.
   1. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
   2. Keep wall wet below area being cleaned to prevent streaking from runoff.

F. Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application.
   1. Periodically during rinsing, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
      a. Repeat rinsing until tested pH of water runoff is between 6.7 and 7.5.

G. Pressure Spraying: Begin using a low pressure setting of between 50 and 100 psi and proceed to higher pressures only after a lower setting has not yielded the desired results. Do not exceed 500 psi, and stop immediately if damage occurs to masonry or masonry joints.
   1. Ensure that pressures used in the cleaning process do not cause additional damage to masonry surfaces and masonry joints.
   2. Mockups shall be used to determine proper pressures. Do not exceed pressures used in approved mockups.
   3. If damage continues to occur after mockup testing, stop work immediately and contact Architect.

3.08 DETERGENT CLEANING

A. Wet surface with cold water applied by low-pressure spray.

B. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.

C. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.

D. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

3.09 NONACIDIC CHEMICAL CLEANING.

A. Wet surface with cold water applied by low-pressure spray.

B. Apply gel cleaner by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
C. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
D. Remove bulk of gel cleaner.
E. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
F. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.10 MILD-ACID CHEMICAL CLEANING

A. Wet surface with cold water applied by low-pressure spray.
B. Apply cleaner to surface by brush or low-pressure spray.
C. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
D. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
E. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.11 PAINT STRIPPING

A. Wet surface with cold water applied by low-pressure spray.
B. Apply gel stripper by brush. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
C. Let stripper remain on surface for period recommended in writing by stripper manufacturer. Periodically agitate with brush.
D. Rinse with hot water applied by low-pressure spray to remove chemicals and soil.
E. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

3.12 BIOLOGICAL CLEANING

A. Wet surface with cold water applied by low-pressure spray.
B. Apply cleaner to surface by brush or low-pressure spray.
C. Let cleaner remain on surface for period recommended in writing by cleaner manufacturer. Periodically agitate with brush to loosen biological soiling.
D. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
E. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

END OF SECTION

SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items, including:
   1. Loose steel lintels.
   2. Bent metal restraints at top of interior masonry walls.
   3. Steel framing supports for the following:
      a. Mechanical and electrical equipment.
      b. Applications where framing and supports are not specified in other Sections.
      c. Other items as indicated on Drawings.
   4. Other items as indicated on Drawings.

B. Slotted channel framing.

1.02 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
I. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
M. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
D. Designer's Qualification Statement.
E. Fabricator's Qulaification Statement.

1.04 QUALITY ASSURANCE

A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Fabricator: Company specializing in performing the work of this section with minimum 5years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500/A500M, Grade B, cold-formed or ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black and hot-dip galvanized finish, as indicated.

E. Slotted Channel Framing:

1. Slotted Channel Framing: ASTM A653/A653M Grade 33.
   a. Channel Size: 1-5/8 by 1-5/8 inches.
   b. Thickness: 0.060 inch (16 gage), minimum.
   c. Finish: Galvanized, G90 coating.
2. Fittings and Fasteners: Manufacturer's standard fittings and fasteners; finished to match slotted channel framing.

F. Bolts, Nuts, and Washers: ASTM A307, Grade A, galvanized to ASTM A153/A153M where connecting galvanized components.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

J. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.02 FABRICATION - GENERAL

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.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 LOOSE STEEL LINTELS

A. General:

1. Fabricate loose steel lintels from steel angles, plates, and other shapes as indicated.
   a. Weld adjoining members together to form a single unit.
2. Size loose steel lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
3. Galvanize loose steel lintels located in exterior walls.
4. Prime loose steel lintels located in interior walls.

5. Provide lintels at openings for all equipment and ductwork.

B. Fabricate loose steel lintels in accordance with the following schedule, unless otherwise indicated:

2.04 BENT METAL RESTRAINTS

A. Bent Metal Restraints: Bent metal restraints that restrain top of interior masonry walls.
   1. Fabricate bent metal restraints from 12 gage, 0.108 inch, thick galvanized sheet steel.
      a. L-shaped: 4 inches wide; each leg 4 inches long. Minimum.
   2. Finish: Prime painted.
   3. Fasteners: As appropriate for indicated substrates.

2.05 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.

C. Finish: Prime painted unless otherwise indicated or at an exterior location.

D. Fabricate support for suspended toilet partitions as follows:
   1. Beams: Continuous steel shapes of size required to limit deflection to L/360 between hangers, but use not less than C8x11.5 channels or another shape with equivalent structural properties.
   2. Hangers: Steel rods, 1/2 inch in diameter, spaced not more than 36 inches o.c.
      a. Thread rods to receive anchor and stop nuts.
      b. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
   3. Braces and Angles: Steel angles of size required to rigidly brace and support beams.

2.06 MISCELLANEOUS

A. Protective Coating: Zinc molybdate alkyd.

B. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.07 FINISHES - STEEL

A. Prepare surfaces to be primed in accordance with SSPC-SP2.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Prime Painting: One coat.
   1. Provide at all fabrications except at galvanized locations and where otherwise indicated.

D. Where indicated, galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
   1. Locations: All exterior locations and elsewhere as indicated.

E. Where indicated, galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
   1. Locations: All exterior locations and elsewhere as indicated.

2.08 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION - GENERAL

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on shop 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 or galvanized, except surfaces to be in contact with concrete.

3.04 BENT METAL RESTRAINTS

A. Space restraints 24 inches on center at top of masonry walls, staggered each side of wall.
B. Secure restraints to substrates with appropriate anchors.

3.05 MISCELLANEOUS FRAMING AND SUPPORTS

A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.06 BOLLARDS

A. Standard Fixed Bollards:
    1. Anchor bollards in place with concrete footings.
        a. Center and align bollards in holes 3 inches above bottom of excavation.
        b. Place concrete and vibrate or tamp for consolidation.
        c. Support and brace bollards in position until concrete has cured.
        d. Hold top of concrete 8 inches below finish grade, unless otherwise indicated.
    2. Fill bollards solidly with concrete, mounding top surface to shed water.
    3. Refer to Section 03 3000 “Cast-in-place Concrete” for concrete.
B. Surface Mounted Bollards:
    1. Anchor bollard baseplate to existing construction with expansion anchors. Provide four anchors per baseplate, unless otherwise indicated.
C. Install sleeve covers according to manufacturer’s written instructions.

3.07 PREFABRICATED STAIR NOSINGS

A. Install stair nosings in one piece for full width of nosing less 1 inch on each side; where possible.
B. Coordinate installation of stair nosings with installation of cast-in-place concrete; refer to Section 03 3000 - Cast-in-Place Concrete.
C. Apply protective coating to concealed surfaces of prefabricated metal stair nosings in contact with concrete.

3.08 TOLERANCES

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

END OF SECTION

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.
B. Nonstructural dimension lumber framing.
C. Preservative treated wood materials.
D. Fire retardant treated wood materials.
E. Communications and electrical room mounting boards.
F. Concealed wood blocking, nailers, and supports.
G. Miscellaneous wood nailers, furring, and grounds.

1.02 REFERENCE STANDARDS

A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
C. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
D. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2018a.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
G. PS 1 - Structural Plywood; 2009.
H. PS 20 - American Softwood Lumber Standard; 2015.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
    1. Species: Unless otherwise indicated, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
    2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER

A. Sizes: Nominal sizes as indicated on drawings, S4S.
B. Moisture Content: Kiln-dry or MC15.

C. Stud Framing (2 by 2 through 2 by 6):
   1. Species: Southern Pine.
   2. Grade: No. 2.
D. Stud Framing Framing (2 by 6 through 4 by 16):
   1. Species: Southern Pine.
   2. Grade: No. 2.
E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Grade No. 2.

2.03 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
B. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Concealed Plywood in Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Stainless steel for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors:
      a. Toggle bolt type for anchorage to hollow masonry.
      b. Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
      c. Bolt or ballistic fastener for anchorages to steel
B. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.
   1. Manufacturers:
      a. Franklin International, Inc; Titebond GREENchoice Heavy Duty Construction Adhesive: www.titebond.com.
      b. Liquid Nails, a brand of PPG Industries, Inc.; LN-903 Heavy Duty Construction Adhesive (Low VOC): www.liquidnails.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
B. Fire Retardant Treatment:
   1. Manufacturers:
      a. Lonza Group: www.wolmanizedwood.com.
      b. Hoover Treated Wood Products, Inc: www.frtw.com.
      c. Koppers, Inc: www.koppersperformancechemicals.com.
      d. Viance, LLC: www.treatedwood.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

2. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
   a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
   b. Treat lumber in locations as indicated
3. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
   a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
   b. Interior rough carpentry items are to be fire retardant treated.

C. Preservative Treatment:
1. Manufacturers:
   a. Lonza Group: www.wolmanizedwood.com.
   b. Hoover Treated Wood Products, Inc: www.frtw.com.
   c. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
   d. Viance, LLC: www.treatedwood.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.
2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
   a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
   b. Treat lumber exposed to weather.
   c. Treat lumber in contact with roofing, flashing, or waterproofing.
      1) At Contractor's option, roof nailers may be non-preservative treated.
   d. Treat lumber in contact with masonry or concrete.
   e. Treat lumber less than 18 inches above grade.
   f. Treat lumber in other locations as indicated.
3. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
   a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
   b. Treat plywood in contact with roofing, flashing, or waterproofing.
   c. Treat plywood in contact with masonry or concrete.
   d. Treat plywood less than 18 inches above grade.
   e. Treat plywood in other locations as indicated.
4. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
5. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

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

3.02 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
C. Install structural members full length without splices.
D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
E. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.
F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
G. Provide bridging at framing in excess of 8 feet span at mid-span and as detailed. Fit solid blocking at ends of members.
H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.03 MISCELLANEOUS FRAMING

A. Install miscellaneous framing level, plumb, and true to line.
B. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
C. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.

3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
C. Provide the following specific nonstructural framing and blocking:
    1. Cabinets and shelf supports.
    2. Wall brackets.
    3. Handrails.
    4. Grab bars.
    5. Towel and bath accessories.
    6. Other locations as indicated.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
    1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
    2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
    3. Install adjacent boards without gaps.
    4. Size and Location: As indicated on drawings.

3.06 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
B. Allow preservative to dry prior to erecting members.

3.07 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 CLEANING

A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cabinets and millwork - specially fabricated.
   1. Plastic-laminate clad cabinets and millwork.
   2. Wood cabinets and millwork.
B. Countertops.- Specified In 12 3600 Countertops
C. Sliding Frameless Service Window with Pass-Thru
D. Miscellaneous items including:
   1. Window stools
   2. Closet and utility shelving.
   3. Other items as indicated on Drawings.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.
B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
F. BHMA A156.18 - Materials and Finishes; 2020.
G. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
H. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
I. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
J. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
K. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
L. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
M. PS 1 - Structural Plywood; 2009.
N. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for the following:
   1. Anchors and fasteners.
   2. Adhesives.
   3. Shop finishing materials.
   4. Fire retardant treatment.
   5. Wood preservative treatment.
C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories. Include the following:
   1. Information required by AWI/AWMAC/WI (AWS).
   2. Dimensioned plans, elevations, and sections.
   3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
   4. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.
D. Samples: Three samples of each of the following:

1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish.
2. Transparent Wood Finishes:
   a. Standing and Running Trim: 4 inches by 12 inches for each species, cut, and finish; finish on one side and one edge.
   b. Door Frames and Borrowed Lite Frames: 4 inches by 12 inches for each species, cut, and finish; finish on one side and one edge.
   c. Wood Cabinets and Millwork: 12 by 12 inches sample for each species, cut, and finish.
3. Solid Surfacing: 4 by 4 inches, for each type, color, pattern, and finish.
4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.
5. Wood Veneer Panel Products: 12 by 12 inches sample for each type and finish.
6. Lumber and Panel Products for Field-applied Opaque Finish: 4 inches wide by 12 inches long for lumber and 12 by 12 inches for panels.
   a. Unfinished.

1.05 QUALITY ASSURANCE

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

B. Single Source Responsibility: Provide and install interior architectural woodwork from single fabricator.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Mockups: When requested by Architect, build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with AWI/AWMAC/WI (AWS).

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas with the same environmental conditions; temperature and humidity conditions in storage areas shall be at the same levels planned for occupancy.

D. Protect units from moisture damage.

1.08 FIELD CONDITIONS

A. During and after installation of architectural woodwork, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Particle Board: ANSI A208.1, Grade M-2.

C. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.

D. Hardwood Plywood: HPVA HP-1.

E. Softwood Plywood: PS 1.

F. Fire Retardant Treatment:
   1. Manufacturers:
      a. Lonza Group: www.wolmanizedwood.com.
      b. Hoover Treated Wood Products, Inc: www.frtw.com.
      c. Koppers, Inc: www.koppersperformancechemicals.com.

d. Viance, LLC: www.treatedwood.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
   a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

G. Preservative Treatment:
1. Manufacturers:
   a. Lonza Group: www.wolmanizedwood.com.
   b. Hoover Treated Wood Products, Inc: www.frtw.com.
   c. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
   d. Viance, LLC: www.treatedwood.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.
2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
   a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
   b. Treat lumber in contact with masonry or concrete.
   c. Treat lumber in other locations as indicated.
3. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
   a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
   b. Treat plywood in contact with masonry or concrete.
   c. Treat plywood at countertop subtops at sinks or other wet locations.
   d. Treat plywood in other locations as indicated.
4. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
5. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

2.02 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as indicated or recommended for specific applications.
1. Manufacturers:
   a. Formica Corporation: www.formica.com.
   b. Panolam Industries International, Inc. Nevamar: www.nevamar.com.
   c. Panolam Industries International, Inc. Pionite: www.pionitelaminates.com.
   d. Wilsonart: www.wilsonart.com.
   e. Substitutions: See Section 01 6000 - Product Requirements Not permitted.
2. Colors, Patterns, and Finishes:
   a. PL1Wilsonart; Steel Mesh 4879-38.
   b. PL-2Formica; Classic White 9244-58.
   c. PL3 Formica; Natural Recycled Kraft 09684-58.

B. Low Pressure Decorative Laminate (LPDL): Melamine resin, NEMA LD 3, Type VGL (0.20 inch thick) laminate panels; thermally fused.
1. Manufacturers:
   a. Panolam Industries International, Inc.: www.panolam.com.
   b. Wilsonart: www.wilsonart.com.
   c. Substitutions: See Section 01 6000 - Product Requirements.
2. Color: White unless otherwise indicated.

C. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness. Match adjacent laminate in color, pattern, and finish.
   1. 0.118 inch (3 mm) thick at doors, drawer fronts, and countertops.
   2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.

2.03 SOLID SURFACING

A. 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 and non-porous; no surface coating; color and pattern consistent throughout thickness.
   1. Manufacturers:
      a. E. I. du Pont de Nemours and Company (Dupont); Corian: www.corian.com.
      b. Substitutions: See Section 01 6000 - Product Requirements Not permitted.
   2. Colors, Patterns, and Finishes:
      a. SS1Carbon Concrete.

B. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
   1. Manufacturers:
      a. E. I. du Pont de Nemours and Company (Dupont); Corian Quartz: www.corian.com.
      b. Substitutions: See Section 01 6000 - Product Requirements Not permitted.
   2. Colors, Patterns, and Finishes: Architect to select up to (1) color from manufacturer's full range.

2.04 ACCESSORIES

A. Support Faming, Grounds, and Concealed Blocking: Refer to Section 06 1000 - Rough Carpentry.

B. Stain and Finishing Materials: In compliance with AWI/AWMAC/WI (AWS), unless noted otherwise.

C. Adhesives: Type recommended by fabricator to suit application.
   1. Do not use adhesives that contain urea formaldehyde.
   2. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Wood Glues: 30 g/L.
      b. Contact Adhesive: 250 g/L.

D. Fasteners: Size and type to suit application.

E. 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.

F. Concealed Joint Fasteners: Threaded steel.

2.05 HARDWARE

A. Cabinet Hardware, General: BHMA A156.9, types as indicated for quality grade specified.
   1. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finish:
      a. Satin Chrome: BHMA 626.
   2. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

B. Hinges: Semiconcealed type, 5 knuckle, institutional grade, hospital tip, 2-3/4 inch overlay, 270 opening angle, 3 way adjustment, 0.095 inch gage, steel with satin finish, Grade 1.
   1. Manufacturers:
      a. Grass America Inc: www.grassusa.com.
      b. Hafele America Co.: www.hafele.com.
      c. Rockford Hinge; Five Knuckle Overlay Hinge, part no. 374: www.rockfordprocesshingesandhardware.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Number of Hinges:
      a. Provide two (2) hinges for doors less than 36 inches high.
      b. Provide three (3) hinges for doors 37 inches to 54 inches high.
      c. Provide four (4) hinges for tall cabinet doors 55 inches to 84 inches high.

C. Drawer Slides: Zinc-plated, steel ball-bearing slides.
   1. Standard Duty, Grade 1:
      a. Self-closing, side mounted and extending under bottom edge of drawer.
      b. Locations: For drawers not more than 3 inches high and 24 inches wide.
   2. Heavy Duty, Grade 1HD-100:
      a. Self-closing, side or bottom mounted; full-extension type.
      b. Locations: For drawers not more than 6 inches high and 24 inches wide.
   3. Heavy Duty, Grade 1HD-200:
      a. Self-closing, side or bottom mounted; full-extension type.
      b. Locations: For drawers more than 6 inches high or 24 inches wide.
   4. Manufacturers:
      a. Accuride International, Inc: www.accuride.com.
      b. Grass America Inc: www.grassusa.com.
      c. Hafele America Co.: www.hafele.com.
      d. Knape & Vogt Manufacturing Company: www.knapeandvogt.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

D. Back-Mounted Pulls:
   1. Product:
      a. Hafele America Co.; Item No. 117.50.610, Wire Handle, Matt Stainless Steel: www.hafele.com.
         1) 110mm (4 inches nominal) Width.
      b. Substitutions: See Section 01 6000 - Product Requirements.

E. Catches: Magnetic catches, BHMA A156.9, B03141.
   1. Available Product:
      a. Hafele America Co.; Model 246.26.702: www.hafele.com.

F. Door and Drawer Silencers: BHMA A156.16, L03011.

G. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated shelf rests, satin chrome finish, for nominal 1 inch spacing adjustments.
   1. BHMA A156.9, B04013.

H. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
   1. BHMA A156.9, B04102; with shelf brackets, B04112.

I. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.
   1. Door Locks: BHMA A156.11, E07121.
   2. Drawer Locks: BHMA A156.11, E07041.
   3. Provide minimum of 2 keys per lock and 4 master keys.
   4. Provide on all drawers and doors, unless otherwise indicated.
   5. Key all cabinets within a room the same, key all rooms differently.

J. Grommets for Cable Passage: 2-1/2 inch OD, solid brass grommets and matching caps with slot for wire passage.
   1. Color: Satin Chrome.
   2. Available Product:
      a. Doug Mockett & Company Inc.; MM6 Series: www.mockett.com.

K. Coat Rod and Brackets:
   1. Rod:
      a. Material: Steel Tubing.
      b. Outside Diameter: 1-5/16 inches.
      c. Wall Thickness: 0.106 inches.
      d. Length: As indicated.
   2. Brackets: Wall flanges; steel.
   3. Finish: Chrome.
   4. Available Product:
      a. Knape & Vogt; KV 770 Series Rod with 764 Wall Flanges: www.knapeandvogt.com.

L. Countertop Support Brackets:
   1. Tee-Shaped Brackets: Fabricated from 6063-T6 extruded aluminum 2 inch by 3 inch by 3/16 inch Tee.
      a. Finish: Black.
      b. Size: 18 inch support unless otherwise indicated.
         1) Manufacturers:
            (a) Rakks Model EH 1818 ; Rangine Corp.: www.rakks.com.
            (b) Or equal by A&M Hardware, Inc.; www.aandmhardware.com.
            (c) Substitutions: See Section 01 6000 - Product Requirements.
      c. Where concealed flush mount is indicated on Drawings, provide the following:
         1) Manufacturers:
            (a) Rakks Model EH1818-FM; Rangine Corp.: www.rakks.com.
            (b) Or equal by A&M Hardware, Inc.; www.aandmhardware.com.
         2) Substitutions: See Section 01 6000 - Product Requirements.
      d. Size: 9 inch support unless otherwise indicated (located at shelves between wall mounted casework and toilet room free-standing shelves).
         1) Manufacturers:
            (a) Rakks Model EH1209-FM ; Rangine Corp.: www.rakks.com.
            (b) Or equal by A&M Hardware, Inc.; www.aandmhardware.com.
            (c) Substitutions: See Section 01 6000 - Product Requirements.

M. Z-Clips: 6063-T6 extruded aluminum z clips. Sized as required to support applied loads.
   1. Manufacturers:
      a. Monarch Metal Fabrication: www.monarchmetal.com.
      b. Eagle Mouldings Inc.: www.eagle-aluminum.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

N. Aluminum Channels and Angles: 6061-T6 extruded aluminum channels, with sharp corners, mill finish, size as required or indicated on Drawings.

2.06 CLOSET ROD AND SHELF

A. Coat Rod and Brackets:
   1. Rod:
      a. Material: Steel Tubing.
      b. Outside Diameter: 1-5/16 inches.
      c. Wall Thickness: 0.106 inches.
      d. Length: As indicated.
   2. Brackets: Wall flanges; steel.
   3. Finish: Chrome.
   4. Available Product:
      a. Knape & Vogt; KV 770 Series Rod with 764 Wall Flanges: www.knapeandvogt.com.

B. Shelf & Rod Bracket
   1. Material: Steel
   2. Finish: Chrome
   3. Available Product:
      a. Knape & Vogt: Closet-Pro Heavy-Duty Shelf & Rod Bracket RP-0045-CH: www.knapeandvogt.com.

C. Shelf
   1. Material: High Pressure Decorative Laminate (HPDL) on particle board core.
   2. Thickness: 0.75 inch.
   3. Depth: 24 inches.
   4. Width: As indicated on drawings.
   5. Finish: PL-2.

2.07 FABRICATION

A. General:
   1. Fabricate woodwork to dimensions, profiles, and details indicated.
   2. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation.
   3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.
      a. Locate openings accurately and use templates to produce accurately sized and shaped openings.
   4. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
   5. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
      a. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
      b. Cap exposed plastic laminate finish edges with material of same finish and pattern, unless otherwise indicated.
   6. Fire Retardant Wood Materials:
      a. Provide UL (DIR) listed and approved identification on fire retardant treated material.
      b. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

B. Cabinets and Millwork:
   1. Assembly: Shop assemble cabinets and millwork for delivery to site in units easily handled and to permit passage through building openings.
   2. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

2.08 PLASTIC LAMINATE CABINETS AND MILLWORK

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Casework Construction Type: Frameless.

C. Door and Drawer Style: Flush Overlay.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

E. Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGL (0.039 inch thick).
   2. Vertical Surfaces: Grade VGS (0.028 inch thick).
   3. Door and Drawer Edges:PVC edge banding, 0.118 inch (3mm) thick, matching laminate in color, pattern, and finish .
   4. Other Edges: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish

5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

F. Semi-exposed Surfaces:
1. For semiexposed backs of panels with exposed surfaces: Grade VGS (0.028 inch thick).
2. Surfaces Other Than Drawer Bodies: Low pressure decorative laminate.
a. Edges of Low Pressure Decorative Laminate Shelves: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish.
3. Surfaces of Drawer Subfronts, Backs, and Sides: Low pressure decorative laminate.
4. Cores of Drawer Subfronts, Backs, and Sides: Hardwood veneer plywood.
5. Drawer Bottoms: Hardwood veneer plywood.

G. Concealed Backs of Panels with Exposed or Semi-exposed Surfaces: Grade BKL (0.020 inch thick).

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Drawer Construction Method: Multiple dovetailed or doweled.

I. All cabinets and millwork shall be fabricated with balance construction.

J. Cabinet and millwork sizes, layouts, and configurations: As indicated on Drawings.

2.09 SLIDING FRAMELESS SERVICE WINDOW WITH PASS-THRU

A. Location: built within interior wall as indicated on drawings.

B. Type of Use: Walk-up.

C. Window Type: Sliding, single horizontal.
1. Operation: Manual.
2. Mounting: Flush with wall surface.
3. Window Size: As indicated on drawings.
4. Frame material: Brushed Nickel.
5. Sidelites: As indicated on drawings.
6. Glazing: As indicated on drawings.
a. Tempered safety glazing.
7. Transaction Counter: Solid Surface.
a. Size: As indicated on drawings.
8. Manufacturers:
a. C.R. Laurence Company: www.crlaurence.com
b. Substitutions: See Section 01 6000 - Product Requirements.
9. Products:
a. Top Guides: D652
b. Upper Channel: D603
c. Nylon Wheels: D650
d. Shoe Extrusion: D610
e. Lower Channel: D603
f. Insert Rails: D601
g. Alternative: Deluxe Packaged Track Assembly D603 upper and D601 Rail with Nylon Rails
1) Item No. D2301BN72
h. Randomly Keyed Glass Showcase Lock
1) Polished Chrome
2) Model No. 220CH
i. Clear Protective Bumpads: CB1PK200
1) Turn unsued bumpads over to owner.
j. Clear showcase Stick-On Finger Pull: FP88
1) One per side of sliding window.

2.10 MISCELLANEOUS ITEMS

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Solid Surface Window Stools: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
C. Closet and Utility Shelving:
   1. Shelf Material: 3/4 inch thick.
      a. Horizontal Surfaces: Low-Pressure Decorative Laminate, NEMA LD 3, Thermoset decorative faces.
      b. Core: Particle board, medium density fiberboard (MDF), or plywood.
      c. Shelf Edges: PVC or polyester edge banding.
   2. Cleats: 3/4-inch solid lumber.

2.11 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.
B. Field Applied Opaque Finishes:
   1. Apply wood filler in exposed nail and screw indentations and sand smooth.
   2. Shop prime with one coat of wood primer as specified in Section 09 9123 - Interior Painting.
   3. Refer to Section 09 9123 - Interior Painting for field painting.
C. Shop Applied Transparent Finishes:
   1. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
   2. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
      a. Transparent Finishes:
         1) Provide one of the following finishes:
            (a) System - 5, Varnish, Conversion.
            (b) System - 9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
            (c) System - 10, UV Curable, Water-based.
            (d) System - 11, Polyurethane, Catalyzed.
         2) Stain: To match Architect's samples.
         3) Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.
B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 PREPARATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.
B. Condition all interior architectural woodwork to temperature and humidity conditions in installation areas for not less than 72 hours prior to installation.
   1. Temperature and humidity conditions shall be same levels planned for occupancy.

3.03 INSTALLATION - GENERAL

A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
B. Install architectural woodwork level, plumb, true in line, and without distortion.
   1. Shim as required with concealed shims.
   2. Install level and plumb to a tolerance of 1/8 inch in 96 inches
C. Scribe and cut architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

3.04 CABINET AND MILLWORK INSTALLATION

A. Set and secure custom cabinets and millwork in place, assuring that they are rigid, plumb, and level.

B. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned.

1. Adjust hardware to center doors and drawers in openings and to provide easy and smooth operation.

C. Use fixture attachments in concealed locations for wall mounted components.

1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips, or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

3.05 COUNTERTOP INSTALLATION

A. Install countertops level; shim where required.

1. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum.
2. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Attach plastic laminate countertops to substrates using concealed screws and fasteners.

D. Attach solid surfacing countertops to substrates with adhesive according to solid surfacing manufacturer's written instructions.

E. Joints: Keep to a minimum; seal with manufacturer's recommended joint adhesive.

1. Joints shall be inconspicuous in appearance, smooth, and without voids.
2. Use adhesive in color to match countertop; form seams according to manufacturer's written instructions.

F. Install back and end splashes to countertop and walls with manufacturer’s recommended adhesive.

G. Apply sealant between back and end splashes and wall.

1. Refer to Section 07 9200 - Joint Sealants for joint sealant.

3.06 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.07 REPAIRING AND CLEANING

A. Repair damaged and defective architectural woodwork, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural woodwork.

B. Clean all architectural woodwork, including, but not limited to, casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 8400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.
   1. Firestopping of joints and penetraftions in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
E. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
F. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a.
G. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
H. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Schedule of Firestopping: List each type of penetration, each type of joint, fire rating of the penetrated assembly, firestopping test or design number, and illustration of each firestopping system.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Installer's qualification statement.

1.04 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) will be considered as constituting an acceptable test report.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Verification of minimum 5 years documented experience installing work of this type.

1.05 MOCK-UPS

A. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall or floor constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.
B. If accepted, mock-up will represent minimum standard for this work.
C. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.06 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Systems; www.3m.com.
   2. A/D Fire Protection Systems; www.adfire.com.
   3. Hilti Firestop; www.hilti.com.
   4. RectorSeal Firestop; www.rectorseal.com.
   5. Specified Technologies, Inc. (STI); www.stifirestop.com.
   6. Tremco Fire Protection Systems; www.tremcofirestop.com.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Firestopping Materials: Any materials complying with firestopping assembly design requirements including, but not limited to, the following:
   1. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
   2. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
   3. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
   4. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
   5. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
   6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
   7. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
   8. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
   9. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
   10. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants

B. Accessory Materials: For each firestopping assembly, provide all primers, forming/damming/backing materials, collars, sleeves, and related materials for a complete installation.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. General:
   1. Provide firestopping assemblies indicated, or, if not indicated, as required to comply with fire ratings indicated.
   2. Fire Ratings: As indicated on Drawings.
   3. Joint Firestopping:
      a. Nominal Widths: As indicated on Drawings.

b. Movement Capabilities: Class 1, 50 percent compression or extension, unless otherwise indicated or required.

B. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. 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.
   a. Temperature Rise: Provide systems that have been tested to show T Rating as indicated or required.
   b. Air Leakage: Provide systems that have been tested to show L Rating as indicated, at Smoke Barriers, and elsewhere as indicated or required.
   c. Watertightness: Provide systems that have been tested to show W Rating as indicated or required.

C. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
   a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
   b. Temperature Rise: Provide systems that have been tested to show T Rating as indicated or required.
   c. Air Leakage: Provide systems that have been tested to show L Rating as indicated or required..
   d. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated or required..
2. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
3. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
   b. Air Leakage: Provide systems that have been tested to show L Rating as indicated or required.
   c. Watertightness: Provide systems that have been tested to show W Rating as indicated or required.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.

C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

3.04 IDENTIFICATION

A. General: Install labeling required by code.

B. Wall Identification:

1. Permanently label walls containing penetration firestopping systems with the words "FIRE /SMOKE BARRIER - PROTECT ALL OPENINGS."
   a. Use lettering not less than 3 inches high and with minimum 0.375-inch strokes.
2. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

C. Penetration Identification:

1. Identify each penetration firestopping system with legible metal or plastic labels.
2. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems.
3. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed.
4. Include the following information on labels:
   a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   b. Manufacturer's name.
   c. Installer's name, address, and phone number.
   d. Designation of applicable testing and inspecting agency.
   e. Date of installation.

3.05 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, may examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.06 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.07 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9200 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 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 C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
J. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes 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.
    6. Sample product warranty.
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 custom colors are not specified, submit manufacturer's color cards showing standard colors available for selection.
E. Samples for Verification: For each sealant color, submit at least three physical samples for color verification.
    1. Provide 1/2 inch wide joint sealant samples formed between two 4 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least 5 years of documented experience.

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
   4. Allow sufficient time for testing to avoid delaying the work.
   5. Deliver to manufacturer sufficient samples for testing.
   6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

D. Owner may employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
   1. Contractor shall cooperate with testing agency and repair failures discovered.
   2. Otherwise, if Owner does not employ an independent testing agency, Contractor shall perform its own field quality control measures including the following:
      a. Field Quality Control Plan and Log.
      b. Field Adhesion Test Procedures.

E. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
      a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 120 inches thereafter.
      b. If any failures occur in the first 10 linear feet, continue testing at 48 inch intervals at no extra cost to Owner.

F. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
   5. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
      a. Record results on Field Quality Control Log.
      b. Repair failed portions of joints.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints as indicated.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Other joints as indicated.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.
      e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
   1. Control and Expansion Joints in Concrete Paving: Self-leveling silicone traffic-grade sealant.

C. Interior Joints: Use non-sag acrylic emulsion latex sealant, unless otherwise indicated.
   1. Interior Sides of Aluminum Framing in Exterior Walls: Use non-sag non-staining silicone sealant, unless otherwise indicated.
      a. Includes, but is not limited to, curtain walls, storefronts, and metal-framed skylights.
   2. Control Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
   3. Column Isolation Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
   4. Floor Joints in Wet Areas: Self-leveling silicone "traffic grade" sealant; not for continuous liquid immersion
   5. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear, unless otherwise indicated.
   6. Joints between countertops and walls: Mildew-resistant silicone sealant; clear, unless otherwise indicated.

D. Interior Wet Areas: Includes, but is not limited to, toilet rooms, showering areas, locker rooms, kitchens, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, M and O; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Hardness Range: Comply with one of the following:

a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
5. Color: Custom color(s) to match Architect's sample(s).
6. Cure Type: Single-component, neutral moisture curing.
7. Service Temperature Range: Minus 40 to 250 degrees F.
8. Products:
a. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: www.siliconeforbuilding.com.
b. Pecora Corporation; 890NST: www.pecora.com.
c. Sika Corporation; Sikasil WS-295 FPS: www.usa.sika.com.
d. Tremco, Inc.; Spectrem 3: www.tremcosealants.com.
e. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
f. Substitutions: See Section 01 6000 - Product Requirements.

B. Traffic Grade Silicone Sealant: ASTM C920, Grade NS, Type S, Uses T, M, and O; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum
2. Hardness Range: Comply with one of the following:
a. 5 to 15, Shore A, when tested in accordance with ASTM C661.
b. 85, Shore 00, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's full range.
4. Cure Type: Single-component, neutral moisture curing.
5. Service Temperature Range: Minus 40 to 250 degrees F.
6. Products:
a. Dow Corning; NS Parking Structure Sealant: www.dowcorning.com.
b. Pecora Corporation; 311NS: www.pecora.com.
c. Sika Corporation; Sikasil - 728 NS: www.usa.sika.com.
d. Tremco, Inc.; Spectrem 800: www.tremcosealants.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, and O; mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: Comply with one of the following:
a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
3. Color: Clear.
4. Cure Type: Single-component, acetoxy or neutral moisture curing .
5. Service Temperature Range: Minus 40 to 300 degrees F.
6. Products:
a. Dow Corning; 786 Sealant M: www.dowcorning.com.
b. Momentive Performance Materials, Inc./GE; SCS1700 Sanitary: www.siliconeforbuilding.com.
c. Pecora Corporation; 898NST: www.pecora.com.
d. Sika Corporation; Sikasil - GP: www.usa.sika.com.
e. Tremco, Inc.; Tremsil 200 with fungicide: www.tremcosealants.com.
f. Substitutions: See Section 01 6000 - Product Requirements.

D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use. Siliconized.
1. Color: To be selected by Architect from manufacturer's full range.
2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
3. Products:
a. Franklin International Inc; Titebond Painter's Plus Caulk: www.titebond.com.
b. Pecora Corporation; AC-20 +Silicone: www.pecora.com.

c. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com.
d. Tremco, Inc.; Tremflex 834: www.tremcosealants.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SELF-LEVELING SEALANTS

A. Self-Leveling Silicone Sealant: ASTM C920, Type S, Grade P, Uses T, M and O; single-component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
2. Hardness Range: Comply with one of the following:
a. 5 to 20, Shore A, when tested in accordance with ASTM C661.
b. 40 to 85, Shore 00, when tested in accordance with ASTM D2240.
3. Color: To be selected by Architect from manufacturer's full range.
4. Cure Type: Single-component, neutral moisture curing.
5. Service Temperature Range: Minus 50 to 300 degrees F.
6. Products:
a. Dow Corning; SL Parking Structure Sealant: www.siliconeforbuilding.com.
b. Pecora Corporation; 310SL: www.pecora.com.
c. Sika Corporation; Sikasil-728 SL: www.usa.sika.com.
d. Tremco, Inc.; Spectrem 900SL: www.tremcosealants.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
3. Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

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, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.
C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
D. Install bond breaker backing tape where backer rod cannot be used.
E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
F. 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.
G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.
I. Installation of Two-Stage Joints at Precast Architectural Concrete Units:
    1. Joint system consists of two back-to-back sealant joints at each precast architectural concrete unit joint with a weep at the bottom of the unit joint per Precast/Prestressed Concrete Institute (PCI) recommendations and as follows:
        a. Inner (Secondary) Seal: Inner secondary backer rod and sealant joint is installed a minimum of 2 to 2-1/2 inches beyond the exposed face of the precast architectural concrete panels within the panel joint itself.
        b. Exterior (Primary) Seal: Following the installation of the secondary joint, the outer primary backer rod and sealant joint is installed at the face of the precast architectural concrete panels with a weep at the bottom of the joint. Leave open continuous air space between the primary backer rod and inner secondary seal.
        c. Install 3/8 inch minimum weep openings in the exterior seal to allow water penetrating the exterior seal and contained by the inner seal to exit the cavity between joint seals.
            1) Do not install weeps below finish grades.
        d. Near the junction of horizontal and vertical joints, the inner seal must turn out to the plane of the exterior seal at regular intervals to force water out of the joint.

3.04 FIELD QUALITY CONTROL

A. Owner may employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
   1. Including fire-rated frames
C. Fire-rated hollow metal doors and frames.
D. Hollow metal borrowed lites glazing frames.

1.02 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.
B. BHMA - Builders Hardware Manufacturers Association.
C. NFPA: National Fire Protection Association.
D. SDI: Steel Door Institute.
E. UL: Underwriters Laboratories.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.; 2003.
C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
G. 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; 2020.
H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
J. ASTM C476 - Standard Specification for Grout for Masonry; 2018.
K. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
M. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
O. ITS (DIR) - Directory of Listed Products; Current Edition.
P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
R. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
S. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
T. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
U. UL (DIR) - Online Certifications Directory; Current Edition.

V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
W. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
    1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
D. Manufacturer's Qualification Statement.
E. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with ANSI 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.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer warranty for doors and frames to be free from material or workmanship defects and within commercial tolerances within a 1 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
    1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
    2. Curries, an Assa Abloy Group company: www.curries.com.
    3. De La Fontaine: www.delafontaine.com.
    4. Mesker/Mesker Openings Group, a Dormakaba Group company: www.meskeropeningsgroup.come.
    5. Pioneer Industries, an Assa Abloy Group company: www.pioneerindustries.com.
    6. Republic Doors, an Allegion brand: www.republicdoor.com.
    7. Steelcraft, an Allegion brand: www.allegion.com.
    8. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
    1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
    2. Accessibility: Comply with ICC A117.1 and ADA Standards.
    3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
    4. Door Edge Profile: Beveled, both sides.

5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115 and ANSI A250.8 (SDI-100) in accordance with specified requirements and as follows:
   a. Minimum Hardware reinforcing thicknesses:
      1) Mortise Butt Hinges: 0.123 inches (10 gage),
      2) Pivot Hinges: 0.167 inches (7 gage)
      3) Continuous Hinges: 0.067 inches (14 gage).
      4) Exit Devices: 0.067 inches (14 gage)
      5) Mortise Locksets and Deadbolts: 0.067 inches (14 gage).
      6) Bored Locksets and Deadbolts: 0.067 inches (14 gage).
      7) Flush and Surface Bolts: 0.067 inches (14 gage).
      8) Closers and Hold Open Arms: 0.067 inches (14 gage).
      9) Pull Plates and Push/Pull Bars: 0.067 inches (14 gage).
      10) Protection Plates and Push Plates: No reinforcing required.
8. Zinc Coating: Where indicated, provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M.
   a. Minimum A60/ZF180 (galvannealed) coating unless otherwise indicated.

B. Hollow Metal In-Fill Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. 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 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2 - Seamless.
   d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.

C. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2 - Seamless.
   d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Temperature-Rise Rating (TRR) Across Door Thickness: 450 degrees F.
   a. Provide where indicated on Drawings and at vertical exit enclosures and exit passageways.
4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.
5. Smoke and Draft Control Doors: Install in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;

a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
b. Gasketing: Refer to Section 08 7100.
c. Label: Include the "S" label on fire-rating label of door.

6. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.

2.04 HOLLOW METAL FRAMES

A. Hollow metal frames based on SDI Standards: ANSI A250.8 (SDI-100).
1. Joints between faces of abutting frame members shall appear seamless; joints shall be securely welded, filled, and and finished smooth without visible seams.

B. Frame Finish: Factory primed and field finished.

C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
2. Includes frames for wood doors.

D. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
3. Includes frames for wood doors.
4. For Exterior Fire-Rated Doors provide the following:
a. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.

E. Borrowed Light Frames: Full profile/continuously welded type.
1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
2. Face dimensions to match door frames.

F. Mullions for Pairs of Doors: Where indicated provide fixed mullions with profile similar to jambs.
1. Refer to Section 08 7100 - Door Hardware for removable mullions.

G. Transom Bars: Fixed, of profile same as jamb and head.

H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

I. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

J. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

K. Frame Anchors:
1. Provide anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Floor Anchors: Base anchors welded to bottom of frames, designed to attach frame to floor.
3. Masonry Anchors: Masonry anchors shall be T-strap type, corrugated or perforated.
4. Stud Anchors: Z-type, welded to back of frames.
5. In-Place Concrete or Masonry Wall Anchors: Minimum 3/8 inch diameter bolts with expansion shields or inserts, with manufacturer's standard spacer.
a. For existing walls or new openings cut into existing walls

2.05 FINISHES

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

B. Corrosion Resistant Back-Coating: Automotive undercoating, asphalt emulsion, or other high-build, water-resistant, resilient coating.

2.06 ACCESSORIES

A. Glazing: As specified in Section 08 8000.

B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.

1. At Contractor's option, instead of glass stops provided by door manufacturer, provide fire rated glass manufacturer’s standard vision lite kits for installing fire-rated glass in doors.
   a. Refer to Section 08 8000 - Glazing.

C. Astragals for Double Doors: Specified in Section 08 7100.

D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
   1. Comply with requirements of Section 04 2000 - Unit Masonry.

E. 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.

F. Filler: Two-component, non-shrinking resin, autobody filler.
   1. Available Products:
      a. 3M/Bondo; Professional Gold Body Filler: www.bondo.com.

G. Mineral Fiber Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread and smoke developed indexes of 0 (zero) when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Back-Coating of Non-Rated Frames: Field-apply corrosion resistant back-coatings to frames that are to be grouted solid.
   1. Do not back-coat fire-rated frames.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

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

C. Install smoke control units in accordance with NFPA 105.

D. Set frames accurately in position, aligned, plumb, and square.

E. Fill head and jamb members with mineral fiber insulation prior to installation.
   1. Exception: Do not fill frames that are to be grouted solid.

F. Grout frames solid in masonry and concrete construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
   1. Install silencers prior to grouting frames.
   2. Do not grout fire-rated frames; instead fill head and jamb members with mineral fiber insulation.

G. Frame Anchors:
   1. Coordinate frame anchor placement with wall construction.
   2. Minimum number of anchors:
      a. Provide 3 jamb anchors per jamb up to 90 inches in height; evenly spaced.
      b. Provide 4 jamb anchors per jamb from 90 to 144 inches in height; evenly spaced.
      c. Provide 1 additional anchor per jamb for each 24 inches or fraction thereof more than 144 inches in height.
      d. Provide 1 floor anchor at the bottom of each jamb or mullion; where a floor anchor is not possible provide one additional jamb anchor.
   3. In-Place Concrete or Masonry Wall Anchor: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

H. Install doors plumb with uniform clearance at jambs and head; doors shall open and close without binding
I. Install glass in accordance with Section 08 8000 - Glazing.
J. Install door hardware as specified in Section 08 7100.
K. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117.
B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.02 REFERENCE STANDARDS

A. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
D. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
F. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
C. 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.
    1. Provide information as required by AWI/AWMAC/WI (AWS).
    2. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems
D. Samples: Submit three samples of door veneer, 8 by 10 inch in size illustrating wood grain, stain color, and sheen.
    1. Transparent finish Samples shall illustrate typical range of wood color and grain.
E. Manufacturer's Qualification Statement.
F. Installer's Qualification Statement.
G. Warranty, executed in Owner's name.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than 5 years of documented experience.

1.05 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. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges if stored more than one week. Break seal on site to permit ventilation.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
    1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Masonite Architectural; Cendura Standard Wood Veneer Doors : www.architectural.masonite.com/#sle.
   2. Mohawk Doors, Masonite Architectural: https://architectural.masonite.com.
   3. Oshkosh Door Company: www.oshkoshdoor.com.
   4. VT Industries, Inc: www.vtindustries.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL) Faced Doors:
   1. Eliason Corporation; StyleCraft: www.eliasoncorp.com/#sle.
   2. Masonite Architectural; Aspiro Choice Laminate Doors: www.architectural.masonite.com/#sle.
   3. Oregon Door: www.oregondoor.com/#sle.
   4. VT Industries, Inc: www.vtindustries.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Premium Grade, Extra Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
   3. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Smoke and Draft Control Doors: In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for "S" label.
   4. Wood veneer facing with factory transparent finish.
   5. High pressure decorative laminate (HPDL) finish as indicated on drawings.

2.03 DOOR CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish:
   1. Species and Cut:
      a. Species: Select White Maple.
      b. Cut: Plain sliced (flat cut).
      c. Grade: HPVA Grade A.
   2. Veneer Matching:
      a. Matching of Adjacent Veneer Leaves: Book match.
      b. Matching Within Door Faces: Center balance match.
   3. Vertical Edges: Same species hardwood edge as face veneer.
   4. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

5. Transoms: Continuous match to doors.

B. Veneer Facing for Opaque Finish: Closed grain hardwood veneer, in compliance with indicated quality standard.

C. High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; .
   1. Color: Wilsonart, Phantom Cocoa, 8213K-28.
   2. Substitutions: Not permitted.

D. Facing Adhesive: Type II - water resistant.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.
   3. Provide sollid mid-rail blocking, in doors indicated to have exit devices.

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

F. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System 5 - Conversion Varnish, System 10 - UV Curable Water-based, or System 11 - Catalyzed Polyurethane.
      b. Stain: As selected by Architect.
      c. Sheen: Satin.

B. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

A. Wood Door Frames: As specified in Section 06 4023 - Interior Architectural Woodwork.

B. Hollow Metal Door Frames: As specified in Section 08 1113 - Hollow Metal Doors and Frames.

C. Glazing: See Section 08 8000.

D. Glazing Stops:
   1. Non-Rated Doors: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws.
      a. Type: Lipped moldings.
   2. Fire-Rated Doors: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws.
      a. Type: Lipped moldings.

E. Door Hardware: See Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.
   2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Use machine tools to cut or drill for hardware.
D. Coordinate installation of doors with installation of frames and hardware.
E. Coordinate installation of glazing.
F. Install door louvers plumb and level.
G. Install glass in accordance with Section 08 8000 - Glazing.
H. Install door hardware as specified in Section 08 7100 - Door Hardware.
I. Coordinate installation of electrical connections to electrical hardware items.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.
B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.
B. Adjust closers for full closure.

END OF SECTION

SECTION 08 1610 - FRP-FACED ALUMINUM DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush aluminum doors with fiberglass reinforced plastic (FRP) face sheets.
   1. Includes FRP-faced aluminum doors installed in storefront framing and curtainwall framing.
B. Aluminum insert framing.

1.02 ABBREVIATIONS

A. FRP: Fiberglass reinforced plastic.

1.03 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
B. AAMA 701/702 - Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals; 2011.
C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
D. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
J. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
K. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
L. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.
M. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
N. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).
O. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2018).
P. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
Q. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
R. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.
S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
T. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's descriptive literature for each type of door and frame; include information on fabrication methods, hardware preparation, accessories, installation, and maintenance instructions.
C. Shop Drawings: Include elevations of each opening type and details at each wall type.
   1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
D. Selection Samples: Complete set of color and finish options, using actual materials, for Architect's selection.
E. Verification Samples: Three actual pieces of products in each finish specified, not less than 4 inches square or 6 inches long for linear components.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum components in manufacturer's standard protective packaging, palleted, crated, or banded together.
B. Inspect delivered components for damage and replace. Repaired components will not be accepted.
C. Store components in clean, dry, indoor area, under cover in manufacturer's packaging until installation.
D. Protect materials and finish from damage during handling and installation.

1.07 FIELD CONDITIONS

A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide ten year manufacturer warranty for defects in workmanship and materials.
C. Provide 25 year warranty on fiberglass reinforced plastic (FRP) face sheets covering delamination, bubbling, and panel corrosion.
D. Provide 20 year warranty on aluminum finishes in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:

1. Special-Lite, Inc.; SL-17 Door: www.special-lite.com.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Aluminum Insert Framing:
1. Special-Lite, Inc.; 10-30 Series Inset Framing: www.special-lite.com.
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DESIGN CRITERIA

A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
B. Factory install door hardware to the greatest extent possible.
C. Accessibility: Conform to ICC A117.1 and ADA Standards.
D. Door Dimensions and Shapes: As indicated on Drawings; dimensions indicated are nominal.
1. Provide the following clearances:
a. Hinge and Lock Stiles: 1/8 inch.
b. Between Meeting Stiles: 1/4 inch.
c. At Top Rail and Bottom Rail: 1/8 inch.

2.03 MATERIALS

A. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy 5005, temper H14, stretcher leveled.
B. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063, temper T5, or alloy 6463, temper T5.
C. Fiberglass Reinforced Plastic (FRP) Face Sheet Properties:
1. Ultraviolet stabilized.
2. Surface Burning Characteristics: Flame spread index (FSI) of 76 to 200, Class C, and smoke developed index (SDI) of 450 or less; when tested in accordance with ASTM E84.
3. Izod Impact Resistance: ASTM D256, 12 ft lbf/inch of width, minimum, with notched izod.
4. Tensile Strength at Break: ASTM D638, 13,000 psi, minimum.
5. Water Absorption: ASTM D570, 0.20 percent, maximum, after 24 hours at 74 degrees F.
6. Flexural Strength: ASTM D790, 21,000 psi, minimum.
7. Barcol Hardness: ASTM D2583, minimum of 50 units.

D. Foam Insulation Fill Material:
1. Manufacturer's standard polystyrene or polyurethane foam.
a. Compressive Strength:
1) Polyurethane: 60 psi; ASTM D1621.
b. Thermal Resistance:
1) Polyurethane: R-value 6.8 per inch, minimum; ASTM C518.

2.04 DOORS

A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:
1. Overall Door Thickness: 1-3/4 inches.
2. Internal Framing: Extruded aluminum tubing, 1/8 inch minimum thickness, with heavy-duty plated steel through bolts in rails.
a. Top and Bottom Rails: 6 inches wide.
b. Side Stiles: 2-1/2 inches wide.
3. Provide manufacturer's standard aluminum and steel reinforcements for door hardware; 1/8 inch minimum thickness.
4. Facing: Seamless laminated FRP sheet.
a. Sheet Thickness: 0.12 inch, minimum.
b. Texture - FRP: Pebble grain.
c. Color: Design Intent: Match adjacent existing dark bronze anodized framing..
5. Perimeter Edges: Extruded aluminum caps or returns that capture and secure edges of FRP face sheets.
a. Door Edge Profile: Hinged edge square, and lock edge beveled.
6. Core: Foam insulation fill material.
7. Vision Lites: Extruded aluminum framed, gasket glazed.

a. Glazing: As specified in Section 08 8000 - Glazing.
8. Aluminum Finish: Superior performing organic coating.
a. Color: Black.
9. Hardware:
a. Weatherstripping: Replaceable pile type; at jambs and head of exterior doors.
b. Bottom Sweep: Manufacturer's concealed adjustable bottom brush.
c. Door Pulls: Provide recessed flush door pulls, unless otherwise indicated.
1) Products:
(a) Special-Lite, Inc.; SL-86: www.special-lite.com.
(b) Substitutions: See Section 01 6000 - Product Requirements.
d. Balance of Hardware: Refer to Section 08 7100 - Door Hardware.

2.05 INSERT FRAMING

A. Insert Framing: Extruded aluminum door framing designed for installation within existing door framing.
1. Extruded aluminum shapes, not less than 0.125 inch thick.
2. Includes integral door stop.
3. Weatherstripping: Replaceable pile type.
4. Corner Joints: Mitered.
5. Finish: Same as doors.

2.06 FINISHES FOR ALUMINUM

A. Superior Performing Organic Coatings: Multiple coats, thermally cured polyvinylidene fluoride (PVDF) system; AAMA 2605.
1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, with minimum 70 percent PVDF color topcoat and minimum dry film thickness 0.9 mil; color and gloss as indicated on drawings.
2. Color: As scheduled.
B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.07 ACCESSORIES

A. Replaceable Weatherstripping: AAMA 701/702 wool pile.
B. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
1. Provide concealed fasteners where possible.
2. Exposed fasteners shall match finish of doors and frames.
C. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.
D. Laminating Adhesive: Manufacturer's standard low-VOC materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.
B. Replace components with damage to exposed finishes.

C. Separate dissimilar metals to prevent electrolytic action between metals.

3.03 INSTALLATION

A. Install doors in accordance with manufacturer's instructions.

B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.

C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.

D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.

E. Install door hardware as specified in Section 08 7100.

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

3.04 FIELD QUALITY CONTROL

A. Provide services of FRP door manufacturer's field representative to observe for proper installation of system and submit report.

3.05 TOLERANCES

A. Tolerances: Install framing systems in accordance with the following tolerances:

1. Variation from Plane: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
2. Offset from Alignment: Maximum offset from true alignment between 2 identical members abutting end to end in line shall not exceed 1/16 inch.
3. Diagonal Measurements: Maximum difference in diagonal measurements shall not exceed 1/8 inch.
4. Offset at Corners: Maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

3.06 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.07 CLEANING

A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.

B. Do not use abrasive, caustic, or acid cleaning agents.

3.08 PROTECTION

A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.

B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

SECTION 08 3100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall- and ceiling-mounted access units.

1.02 DEFINITIONS

A. Wet Areas: Includes the following:
   1. Exterior locations.
   2. Showers.
   3. Other areas as indicated.

B. Non-Wet Areas: Areas that are not indicated or listed as wet areas including, but not limited to, the following:
   1. Kitchens.
   2. Locker rooms.
   3. Toilet rooms.
   4. Janitor closets.

1.03 REFERENCE STANDARDS

A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2020.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ITS (DIR) - Directory of Listed Products; Current Edition.

D. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

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

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

D. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel: Sheet complying with the following:
   1. All areas except wet areas: ASTM A1008/A1008M.
   2. Wet areas: ASTM A653/A653M Grade 33; A40 galvannealed.

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:
   1. Acudor; www.acudor.com.
   2. Babcock-Davis; www.babcockdavis.com.
   3. JL Industries/Activar Construction Products Group, Inc; www.activarcpg.com/jl-industries.
   4. Karp Associates, Inc; www.karpinc.com.
   5. Larsen’s Manufacturing Company: www.larsenmfg.com.
   6. Milcor / Hart & Cooley Inc; www.milcorinc.com.
   7. MIFAB, Inc.; www.mifab.com.
   8. Nystrom; www.nystrom.com.

9. Substitutions: See Section 01 6000 - Product Requirements.

B. General:
1. Factory fabricate doors and frames.
2. Fully assemble units with corner joints welded, filled and ground flush; square and without rack or warp.
3. Coordinate requirements with type of installation assembly being used for each unit.

C. Flush Access Doors with Exposed Flanges:
1. Locations: Masonry.
2. Material: Steel.
3. Style: Exposed frame with door surface flush with frame surface.
   a. Masonry Mounting Criteria: Provide masonry anchor straps.
4. Door Style: Single thickness with rolled or turned in edges.
5. Doors: 14 gage, 0.0747 inch, minimum thickness.
6. Frames: 16 gage, 0.0598 inch, minimum thickness.
7. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
8. Door/Panel Size: As indicated on the drawings.
9. Hardware:
   a. Hinges: Concealed, constant force closure spring type.
   b. Handle: No handle.
   c. Latch/Lock: Screw driver slot for quarter turn cam latch.
   d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

D. Flush Access Doors with Concealed Flanges:
1. Locations: Gypsum board.
2. Material: Steel.
3. Style: Concealed flange for drywall.
   a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
4. Door Style: Single thickness with rolled or turned in edges.
5. Doors: 14 gage, 0.0747 inch, minimum thickness
6. Frames: 16 gage, 0.0598 inch, minimum thickness.
7. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
8. Door/Panel Size: As indicated on the drawings.
9. Hardware:
   a. Hinges: Concealed, constant force closure spring type.
   b. Handle: No handle.
   c. Latch/Lock: Screw driver slot for quarter turn cam latch.
   d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

E. Fire-Rated, Flush, Uninsulated, Access Doors with Exposed Flanges:
1. Locations: Masonry.
2. Material: Steel.
3. Style: Exposed frame with door surface flush with frame surface.
   a. Masonry Mounting Criteria: Provide masonry anchor straps.
4. Door Style: Single thickness with rolled or turned in edges.
5. Doors: 16 gage, 0.0598 inch, minimum thickness
6. Frames: 16 gage, 0.0598 inch, minimum thickness.
7. Fire-Rating: 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.
8. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
9. Door/Panel Size: As indicated on the drawings.
10. Hardware: Automatic closing, self-latching, with interior latch release.
    a. Hinges: Exposed, continuous piano hinge.

b. Handle: No handle.
c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.

F. Fire-Rated, Flush, Uninsulated, Access Doors with Concealed Flanges:
1. Locations: Gypsum board.
2. Material: Steel.
3. Style: Concealed flange for drywall.
a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
4. Door Style: Single thickness with rolled or turned in edges.
5. Doors: 16 gage, 0.0598 inch, minimum thickness
6. Frames: 16 gage, 0.0598 inch, minimum thickness.
7. Fire-Rating: 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.
8. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
9. Door/Panel Size: As indicated on the drawings.
10. Hardware: Automatic closing, self-latching, with interior latch release.
a. Hinges: Exposed continuous piano hinge.
b. Handle: No handle.
c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront.
B. Insulated infill panels.
C. Aluminum doors and frames.

1.02 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 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
G. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
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 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.
N. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
O. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
P. 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.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, 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.
   1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
D. Samples:
   1. Submit three samples for each finish specified, not less than 6 inches square or 6 inches long for linear components.
   2. Submit three samples of infill panels for each color and finish, not less than 6 inches square.
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. Include storefront manufacturer's field representative's field observation reports.
G. Designer's qualification statement.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience.
C. Installer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience and approved by manufacturer.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-ups.
B. Provide minimum 4 by 8 feet mock-up including each component being used on the project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
C. Locate on-site where directed by Architect; mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Provide five year manufacturer's warranty for defects in workmanship and materials.
C. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermally Broken Storefront Products:
   1. Basis of Design: Kawneer North American, an Arconic company; Trifab VG 451T Framing System: www.kawneer.com.

2. Other Manufacturers: Provide either the product identified as "Basis of Design" or one of the following equivalent products:
   a. CMI Architectural; Series 450TB: www.cmiarch.com.
   b. EFCO Corporation, an Apogee Enterprises, Inc. company; Series 433: www.efcocorp.com.
   c. Manko Window Systems, Inc.; 2450FS Series: www.mankowindowsystems.com.
   d. Tubelite Inc, an Apogee Enterprises, Inc. company; 14000 / 14000-I/O Series: www.tubeliteinc.com.
   e. YKK AP America, Inc.; YES 45 TU: www.ykkap.com.
   f. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Non-Thermally Broken Storefront Products:
   1. Basis of Design: Kawneer North American, an Arconic company; Trifab VG 450 Framing System: www.kawneer.com.
   2. Other Manufacturers: Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      a. CMI Architectural; Series 450FG: www.cmiarch.com.
      b. EFCO Corporation, an Apogee Enterprises, Inc. company; Series 401: www.efcocorp.com.
      c. Manko Window Systems, Inc.; 450 Series: www.mankowindowsystems.com.
      d. Tubelite Inc, an Apogee Enterprises, Inc. company; 4500 Series: www.tubeliteinc.com.
      e. YKK AP America, Inc.; YES 40 FS: www.ykkap.com.
      f. Substitutions: Refer to Section 01 6000 - Product Requirements.

C. Swing Door Manufacturers:
   1. Any of the manufacturers specified for storefront products.

D. Source Limitations: Obtain storefront systems, including swing doors, from one manufacturer.
   1. Storefront systems shall be same manufacturer as that of curtain wall specified in Section 08 4413 - Glazed Aluminum Curtain Walls.

2.02 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Thermal Breaks: Manufacturer's standard pour and debridge system.
   2. Glazing Rabbet: For 1 inch insulating glazing, unless otherwise indicated.
   3. Glazing Position: Centered (front to back).
   4. Framing Face Width: 2 inches.
   5. Framing Depth: 4-1/2 inches.
   6. Finish: Class I color anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   7. Finish Color: As selected by Architect from manufacturer's standard line.
   8. 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.
   9. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   10. 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.
   11. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

12. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
13. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Design Wind Loads: Comply with requirements of ASCE 7 and as indicated on Drawings; not less than 25 lbf/ sq ft.
   b. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
3. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503.
4. Overall U-value Including Glazing: 0.42 Btu/(hr sq ft deg F), maximum.
5. Design door frames to resist unauthorized entry when a 200 pound opening load acting upon the exterior door handle is applied to the locked door.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.
3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
   a. Provide as required to comply with performance requirements.

B. Glazing: See Section 08 8000.

C. Infill Panels: Insulated, aluminum, with edges formed to fit glazing channel and sealed.
1. Total Nominal Thickness: 1 inch.
2. Overall Thickness: 1 inch.
3. Face Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.
4. Core: Rigid polystyrene (EPS) insulation core with R-value of 4.
5. Back Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.
6. Finish: Same as storefront.
7. Products:
   a. Citadel Architectural Products; GlazeGuard 1000 WR+; www.citadelap.com.
   b. Laminators, Inc.; Thermolite; www.laminatorsinc.com.
   c. Mapes Panels LLC; Corelite: www.mapespanels.com.
   d. Substitutions: Refer to Section 01 6000 - Product Requirements.

D. Swing Doors: Glazed aluminum.
1. Style: Wide style.
2. Thickness: 1-3/4 inches.
3. Top Rail: 5 inches wide.
4. Vertical Stiles: 5 inches wide.
5. Bottom Rail: 10 inches wide.
6. Glazing Stops: Square.
7. Finish: Same as storefront.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
D. Fasteners: Stainless steel.
E. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
F. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness.
G. Glass and Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 HARDWARE

A. For each door, include weatherstripping and sill sweep strip.
B. Other Door Hardware: See Section 08 7100.
C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
D. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify that storefront wall openings and adjoining flashings, water-resistive and/or air barrier seal materials are ready to receive work of this section.
   1. Notify Architect immediately of any deficient locations.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
I. Install glass and infill panels in accordance with Section 08 8000 - Glazing.
J. Install door hardware as specified in Section 08 7100 - Door Hardware.
K. Coordinate installation of electrical connections to electrical hardware items.
L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

B. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.
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 three tests in each designated area as directed by Architect.
    2. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.
D. Owner may engage an independent inspection agency to perform additional tests and inspections as follows:
    1. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
        a. Perform a minimum of three tests in each designated area as indicated on drawings.
        b. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.
        c. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 8 psf.
            1) Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
        d. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 6.20 psf.
            1) Maximum allowable rate of air leakage is 0.09 cfm/sq ft.
E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.
B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 5800 - ALUMINUM INTERIOR SLIDING SERVICE WINDOW

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes:
   1. Aluminum, medium-duty interior sliding service windows as indicated in drawings and in sections.

1.02 SUBMITTALS

A. Product Data: Submit Manufacturer's technical product data substantiating that products comply.
B. Shop drawings: Submit for fabrication and installation of windows. Include details, elevations and installation requirement of finish hardware and cleaning.
C. Certification: Provide printed data in sufficient detail to indicate compliance with the contract documents.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver windows crated to provide protection during transit and job storage
B. Inspect windows upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.
C. Store windows at building site under cover in dry location.

1.04 PROJECT CONDITIONS

A. Field measurements: Check opening by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.05 WARRANTY

A. All material and workmanship shall be warranted against defects for a period of one (1) yesr from the original date installation.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S

A. Basis of design: Design is based on aluminum, interior sliding service window manufactured by C.R. Laurence Co., Inc. (800) 421-6144

2.02 MATERIALS

A. Frames: Aluminum frame modules shall be constructed of 6063-T5 extruded aluminum. Window rolls on top-hung ball bearing rollers. Catch locks included with all interior windows. Overall frame sizes are to be in accordance with the contract drawings.
B. Finish: All aluminum to be clear anodized, or duranodic bronze.
C. Glazing: The glazing vinyl supplied is for ¼" in thickness. Glass not included, to be supplied by others.
D. Keyed lock, full bottom track, D7 Overhead track.
E. Models: Florence (OX or XO),. X = sliding panel, O = fixed panel, as viewed from clerks side.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install window in accordance with manufacturer's printed instructions and recommendations. Repair damaged units as directed (if approved by the manufacturer and the architect) or replace with new units.

3.02 CLEANING

A. Clean frame and glazing surfaces after installation, complying with requirements contained in the manufacturer's instructions. Remove excess glazing sealant compounds, dirt or other substances.

3.03 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that all the windows do not incur any damage or deterioration, other than normal weathering, at the time of acceptance.

END OF SECTION

SECTION 08 7100 – DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes hardware for doors specified in “Hardware Sets”.

B. Related Divisions:
1. Division 03 Concrete
2. Division 06 Rough & Finish Carpentry
3. Division 07 Joint Sealants
4. Division 08 Openings
5. Division 09 Finishes
6. Division 14 Elevators
7. Division 25 Integrated Automation
8. Division 26 Electrical
9. Division 27 Communications
10. Division 28 Electronic Safety and Security

1.02 REFERENCES

A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI):
1. ANSI/BHMA A156.1 Butts & Hinges (2016)
2. ANSI/BHMA A156.3 Exit Devices (2020)
3. ANSI/BHMA A156.4 Door Controls – Closers (2019)
4. ANSI/BHMA A156.5 Cylinders and Input Devices for Locks (2020)
5. ANSI/BHMA A156.6 Architectural Door Trim (2015)
6. ANSI/BHMA A156.7 Template Hinge Dimensions (2016)
7. ANSI/BHMA A156.8 Door Controls – Overhead Stops and Holders (2015)
8. ANSI/BHMA A156.13 Mortise Locks & Latches (2017)
9. ANSI/BHMA A156.16 Auxiliary Hardware (2018)
10. ANSI/BHMA A156.18 Materials & Finishes (2020)
11. ANSI/BHMA A156.19 Power Assist & Low Energy Power Operated Doors (2019)
12. ANSI/BHMA A156.21 Thresholds (2019)
13. ANSI/BHMA A156.22 Door Gasketing Systems (2017)
14. ANSI/BHMA A156.25 Electrified Locks (2018)
15. ANSI/BHMA A156.26 Continuous Hinges (2017)
16. ANSI/BHMA A156.28 Keying Systems (2018)
17. ANSI/BHMA A156.31 Electric Strikes (2019)
18. ANSI/BHMA A156.35 Power Supplies for Electronic Access Control (2020)
19. ANSI/BHMA A156.36 Auxiliary Locks (2020)

B. International Code Council/American National Standards Institute (ICC/ANSI)/ADA:
1. ICC/ANSI A117.1 Standards for Accessible and Usable Buildings and Facilities.

C. Door and Hardware Institute (DHI):
1. DHI Publication – Abbreviations and Symbols (2019).
2. DHI Publication – Installation Guide for Doors and Hardware (2020).
3. DHI Publication – Sequence and Format of Hardware Schedule (2019).

D. National Fire Protection Agency (NFPA):
1. NFPA 70 National Electrical Code.
2. NFPA 80 Standard for Fire Doors and Other Opening Protectives.
3. NFPA 105 Standard for the Installation of Smoke Door Assemblies.

1.03 SUBMITTALS

A. Submit in accordance with Conditions of the Contract and Division 01 Administrative Requirements and Submittal Procedures Section.

B. Shop Drawings:
   1. Schedule hardware in vertical format using the DHI publication Sequence and Formatting for the Hardware Schedule.
   2. Include abbreviations and symbols page to include manufacturers' abbreviations, finish code descriptions, and fastener abbreviations including descriptions according to the DHI publication Abbreviations and Symbols.
   3. Detail headings referencing the Architect's heading, opening number, locations, fire rating, handing, degree of opening, and description of the opening elements. Include Voltage, amperage, and operational descriptions for openings that have electrified hardware.
   4. Coordinate final door hardware schedule with doors, frames, and related work listing proper sizing of hardware, addressing door thickness, handing, function, mounting accessories, and finish of hardware.
   5. List related door devices specified in other Sections for each opening.
   6. Architectural Hardware Consultant (AHC), as certified by DHI, who will affix seal attesting to completeness and correctness, including the review of the hardware schedule prior to submittal.

C. Product Data:
   1. Furnish manufacturers' catalog sheets on design, grade, and function of items listed in hardware schedule. Submit only relevant information and circle or highlight the technical information including: model numbers, sizing information, voltage and amperage requirements, options and accessories required, means of fastening, listings of fire-rated applications, and finishes.

E. Templates:
   1. Within fourteen days of receiving approved door hardware submittals submit complete list of templates for each hardware item to the opening manufacturers and the installers. Include detailed lists of the hardware location requirements for mortised and surface applied hardware.

F. Wiring Diagrams: Detail a title block for each drawing that includes the project name, project address, architect name, architect's opening number, hardware set, date, and name of the author.
   1. Elevation Riser Drawings:
      a. Furnish one set of elevation drawings with each hardware schedule submittal for hardware sets that contain electrified hardware. Illustrate the openings with proportional representations of the opening and electrified hardware components and dimension their mounting locations as well as sizes of junction boxes and power supplies. Label the components, wire quantities and gauges, high voltage requirements, as well as other building interfaces. Create a legend that complements the drawings with brand names, model numbers, and include voltage and amperage requirements. Add an operational description that includes the normal state of the door, ingress, egress, and what happens in case of power loss or fire alarm activation and any special conditions.
      b. Upon receipt of approved hardware correct and resubmit elevation drawings with the point-to-point and system drawings.
   2. Point-to-Point and System Drawings: Upon receipt of approved hardware schedule, submit point-to-point per hardware set and a system drawing. Cross-reference all wiring diagrams and the associated drawings to each other.

a. Point-to-Point Drawings: Draw each product in a realistic representation including each terminal including those not used, and lines representing wires from component to component, labeling wire colors and gauges.
b. System Drawing: illustrate all equipment and building interfaces required for the entire system. Include room labels and locations, opening numbers and locations.

G. Closeout Submittals: Include the following information as well as highlight and flag fire rated openings for annual inspections:
1. Cover page with required information:
a. Project name
b. Hardware supplier's name and contact information.
c. Date of substantial completion.
2. Final record hardware schedule.
3. Product Data.
4. Keying Schedule.
5. Record Wiring Diagrams.
a. System Drawing.
b. Elevations.
c. Point-to-Point Drawings with all final wire colors noted as terminated. (Include network IP and/or MAC addresses of field devices).
6. Operating and Maintenance Manual.
7. Warranty Information.
8. Maintenance service agreement(s).

1.04 QUALITY ASSURANCE

A. Hardware supplier shall employ an Architectural Hardware Consultant (AHC) as certified by DHI and a member of the seal program who will be available at reasonable times during course of work for Project hardware consultation.
1. Electrified Door Hardware Supplier Qualifications: Experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that is indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
2. Access and Electrified Security Supplier Qualifications: Experienced supplier who has completed projects with access and electrified security door hardware similar in material, design, and extent to that is indicated for this Project, whose work has resulted in construction with a record of successful in-service performance and be a factory authorized distributor.

B. Where openings are required to be accessible door hardware shall conform to ICC/ANSI A117.1.

C. Fire Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware complying with NFPA 80 that are listed and/or labeled by a qualified testing agency for fire-protection ratings indicated.

D. Smoke and Draft Control Door Assemblies: Where smoke and draft control doors are required, provide door hardware that meets requirements of assemblies in compliance with NFPA 105.

E. Door hardware certified to ANSI/BHMA standards as noted, manufacturer must participate and be listed in BHMA Certified Products Directory.

F. Substitution requests shall be submitted in compliance with Division 01: create a comparison chart that includes the testing information as well as the warranty for both the specified product and the proposed substitution. Include the reason for requesting the substitution, clear catalog copy highlighting the proposed product and options, compliance statement, technical data,

product warranty and lead time, to show how the proposed can meet or exceed established level of design, function, and quality.

G. Meetings: Comply with requirements in Division 01 Section “Project Meetings.”
   1. Low-voltage Coordination Meeting
      a. Prior to furnishing door hardware submittals, convene a low-voltage coordination meeting. Meeting participants should include all affected trades including the following, but not limited to: Contractor, installer, supplier, electrical contractor, security consultant and installer, Owner’s IT representative, and fire alarm consultant.
      b. Review sequence of operation for each opening with electrified hardware to ensure that every opening functions properly for the Owner’s use.
      c. Discuss the types of electrified door hardware, inspection, and electrical roughing-in and other preparatory work performed by other trades.
      d. Verify wire quantities, wire types, wire sizes, conduit sizes, and locations including if the power supplies will be centrally located or if they will be located near each opening.
      e. Coordinate the door hardware, power supplies, back-up power requirements, access control components, fire alarm interfaces, elevator controls, and related building systems have all proper and necessary components to interface and operate correctly.
   2. Keying Meeting
      a. Within fourteen days of receiving approved door hardware submittals, contact Owner to establish a keying conference. Include keying meeting decisions into final keying schedule submittal after reviewing the following, but not limited to:
         i. Function of the building, flow of traffic, individual area’s purpose, and degree of security.
         ii. Lock functions and operation.
         iii. Preliminary key system schematic diagram.
         iv. Verify existing keyway(s), and/or proposed keyway(s)
         v. Visual key and cylinder identification
         vi. Quantity of keys required including master level keys, change keys, and keys per lock.
         vii. Review the key control system.
         viii. Determine the recipient and contact information for the delivery of keys and accessories.
   3. Pre-installation Meeting
      a. Convene meeting within fourteen days of receiving approved door hardware submittals. Participants from all affected buildings trades shall attend. Minimum participants should include: Contractor, installer, material supplier, manufacturer representatives, electrical contractor, security consultant, and fire alarm consultant.
      b. Inspect and discuss preparatory work performed by other trades.
      c. Include in-conference decisions regarding proper installation methods and procedures for receiving and handling hardware.
      d. Review all system, elevation, and point-to-point drawings to ensure that all necessary components are provided and detailed.
      e. Review and finalize construction schedule and verify availability of materials, installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
      f. Review required testing, inspecting, and certifying procedures.

H. Installer Qualifications: Specialized in performing installation of this Section and have five years minimum documented experience.
   1. Electrified Hardware Supplier Qualifications: Experienced door hardware installer who has installed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

2. Access Control and Electrified Security Installer Qualifications: Experienced installer who has completed projects with access and electrified security door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance and be a factory authorized to install and commission the system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Pack each item complete with necessary parts and fasteners in manufacturer's original packaging.

B. Mark hardware that is not bulk packed with architect's opening number, hardware set number, and item number for each type of hardware. Include keyset symbols and corresponding hardware component for keyed products. Mark hardware that is bulk packed with manufacturers' part number and reference all hardware sets associated.

C. Deliver hardware to the job site according to the phasing agreed upon in the pre-installation meeting. Inventory the delivery with the supplier's assistance. Immediately note shortages and damages on the shipping receipts and bill of ladings. Coordinate replacement or repair with the supplier.

D. Deliver permanent keys, cores, access control credentials, software, and related accessories directly to Owner via registered mail or overnight package service. Establish the instructions for delivery to Owner at "Keying Conference."

E. Provide a clean, dry, and secure room for hardware delivered. Shelve hardware off the floor and with larger items of hardware stored on pallets. Arrange locksets and keyed cylinders by opening number. Organize the balance of hardware by brand, model of hardware, and hardware set number. Leave the door markings of the hardware visible for installers.

F. Waste Management and Disposal: Separate waste materials for use or recycling in accordance with Division 01.

1.06 WARRANTY

A. General Warranty: Comply Division 01 for Warranty requirements.

B. Special Warranty: Warranties specified in this article will not deprive Owner of other rights.
1. Ten years for manual door closers.
2. Five years for mortise, auxiliary and bored locks.
3. Five years for exit devices.
4. One year for electromechanical door hardware.
5. All access and electrified security equipment and systems will be warranted for a period of one (1) year commencing with the filing date of the Notice of Completion, provided the system has been inspected and signed off by a factory authorized installer and the factory authorized commissioning agent.

1.07 MAINTENANCE

A. Maintenance Tool and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, removal, and replacement of door hardware.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:
1. Produce hardware units of basic metal and forming method using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified within this specification section for applicable hardware units for finish designations indicated.

B. Fasteners:
1. Furnish screws for installation with each hardware item. Use only fasteners that are furnished by the hardware manufacturer to meet the manufacturer’s templating requirements, warranty and NFPA 80 requirements.
2. Provide Phillips-head screws except as otherwise indicated.
3. Finish exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
4. Use machine screws with lead expansion shields at hardware mounting to masonry walls and floors.
5. Wood screw with plastic anchors at drywall applications without reinforcement and wood screws at applications with reinforcements.
6. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.
   a. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.
   b. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex nut fasteners.
7. At exterior openings furnish stainless-steel fasteners for exposed fasteners, for example thresholds and screw-applied weatherstripping.

2.02 CONVENTIONAL HINGES

A. Hinges, electric hinges, and self-closing hinges of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Products to be certified and listed by the following:
1. Butts and Hinges: ANSI/BHMA A156.1.
2. Template Hinge Dimensions: ANSI/BHMA A156.7.
3. Self-Closing Hinges: ANSI/BHMA A156.17.

C. Butt Hinges:
1. Hinge weight and size unless otherwise indicated in hardware sets:
   a. Doors up to 36” wide and up to 1-3/4” thick provide hinges with a minimum thickness of .134” and a minimum of 4-1/2” in height.
   b. Doors over 36” wide up to 48” wide and up to 1-3/4” thick provide hinges with a minimum thickness of .145” and a minimum of 5” in height.
   c. Doors greater than 1-3/4” thick provide hinges with a minimum thickness of .190” and a minimum of 5” in height.
   d. Width of hinge is to be minimum required to clear surrounding trim.
   e. Doors considered to be low to medium frequency use would require standard weight hinges and medium to high frequency use would require heavy weight hinges.
2. Base material unless otherwise indicated in hardware sets:
   a. Exterior Doors: 304 Stainless Steel, Brass or Bronze material.

b. Interior Doors: Steel material.
c. Fire Rated Doors: Steel or 304 Stainless Steel materials.
d. Stainless Steel ball bearing hinges to have stainless steel ball bearings. Steel ball bearings are unacceptable.

3. Quantity of hinges per door unless otherwise stated in hardware sets:
   a. Doors up to 60” in height provide 2 hinges.
   b. Doors 60” up to 90” in height provide 3 hinges.
   c. Doors 90” up to 120” in height provide 4 hinges.
   d. Doors over 120” in height add 1 additional hinge per each additional 30” in height or fraction thereof.
   e. Dutch doors provide 4 hinges up to 120” in height and 1 additional per each additional 30” in height or fraction thereof.
4. Hinge design and options unless otherwise indicated in hardware sets:
   a. Hinges are to be of a square corner five-knuckle design, flat button tips and have ball bearings unless otherwise indicated in hardware sets.
   b. Out-swinging lockable and access-controlled doors are required to have Non-Removable Pins (NRP) to prevent removal of pin while door is in closed position.
   c. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.

D. Acceptable Manufacturers:
1. Hager Companies
2. Stanley
3. McKinney

2.03 ALUMINUM GEARED CONTINUOUS HINGES

A. Continuous hinges of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Products to be certified and listed by ANSI/BHMA A156.26 Grade 1.

C. Determine final model numbers and accessories required using the following criteria:
1. Door inset in relation to the frame face.
2. Door thickness and weight.
3. At fire rated openings provide hinges that carry a UL certification, up to and including 90-minute applications for wood doors and up to 3-hour applications for metal doors and provide studs as required by the manufacturer’s listings.
4. Provide heavy-duty hinges for high frequency and exterior applications.
5. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.
6. Size length of hinge to equal the actual door height unless otherwise stated in hardware sets.

D. Material and Design:
1. Base material: Anodized aluminum manufactured from 6063-T6 material; unexposed working metal surfaces be coated with TFE dry lubricant.
2. Bearings:
   a. Continuous hinges are to have a minimum spacing between bearings of 2-9/16”. Typical door from 80” to 84” in height to have a minimum of 32 bearings.
3. Options:
   a. Provide factory-cut preparations for concealed electric power transfers.

E. Acceptable Manufacturers:
1. Hager Companies

2. National Guard Products
3. Select

2.04 POWER TRANSFER

A. Power transfer of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:
   1. UL Listed Miscellaneous Fire Door Accessories.
   2. UL 10C Listed for up to 3 hours on fire-rated doors and frames.
   3. Classified according to Uniform Building Code (UBC) Standard 7-2, Fire Test of Door Assemblies (1997).

C. Design:
   1. Stainless steel tubular wire transfer and cast housing with steel back boxes to provide weather and tamper resistance when door is open or closed.
   2. Mortise door and frame installation
   3. Two 18 ga wires, 5 amps @ 12/24 VAC/DC.

D. Acceptable Manufacturers:
   1. Hager Companies
   2. Security Door Controls
   3. Von Duprin

2.05 FLUSH BOLTS AND COORDINATORS

A. Flush bolts of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer to be listed by the following: Auxiliary Hardware: ANSI/BHMI A156.16.

C. Labeled openings: Provide automatic or constant latching flush bolts per hardware schedule for inactive leaf of pairs of doors. Provide dust proof strikes for bottom bolt.

D. Non-Labeled openings: Provide two flush bolts for inactive leaf of pairs of doors per hardware schedule. Provide extension rods so that the center line of the top flush bolt is not more than 78” above the finish floor. Provide dust proof strike from bottom bolt.

E. Acceptable Manufacturers:
   1. Hager Companies
   2. Burns Manufacturing
   3. Don Jo

F. Coordinators: Provide for labeled pairs of doors with automatic flush bolts or with vertical rod exit device with a mortise-locking device per hardware schedule. Provide filler piece to extend full width of stop on frame. Provide mounting brackets for closers and special preparation for latches where applicable.

G. Acceptable Manufacturers:
   1. Hager Companies
   2. Burns Manufacturing
   3. Don Jo

2.06 REMOVABLE MULLIONS

A. Keyed and non-keyed removable mullions of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer to be listed by the following: UL/cUL/Warnock Hersey for fire-rated pairs of doors up to 8 feet tall x 8 feet wide opening.

C. Material and Design:
   1. For use with rim exit devices on non-rated and fire rated pairs of doors. Mullion 2” x 3” x 11 gage steel tube.
   2. Top Fitting:
      a. Mullion locked in place without use of a key.
      b. Deadlock on fire-rated device

D. Acceptable manufacturers for keyed and non-keyed removable mullions:
   1. Hager Companies
   2. Detex
   3. Von Duprin

2.07 ELECTRIC STRIKES (Mortise and Cylindrical)

A. Provide for use with type of locks shown on hardware schedule.

B. Products to be certified and listed by the following:
   1. ANSI/BHMA A156.31 Electric Strikes and Frame Mounted Actuators Grade 1.
   2. UL Tested 1500 lb. static strength.
   3. UL listed for Fire Doors and Frames where applicable.
   4. UL 1034 Burglary Resistance.
   5. UL 10C.3H fire-rated, 4’ x 8’ door.

C. Material and Design:
   1. To accept up to 3/4” latch bolt.
   2. Field reversible, Fail Safe or Fail Secure.
   3. Dual voltage 12/24 VDC.
   4. Tamper resistant, stainless steel corrosion resistance parts, and cast body and keeper.

D. Options:
   1. Latch Bolt Monitoring (LBM) Signals the door is closed and latched or unlatched and open.
   2. Door Secure Monitor (DSM) Door secure and unlocked monitoring.
   3. Plug in buzzer (BUZZ) Indicates Fail Secure strike is energized and unlocked.
   4. Rectified (RECT) Converts AC to DC.

E. Acceptable Manufacturers:
   1. Security Door Controls
   2. Securitron
   3. Von Duprin

2.08 ELECTRIC STRIKES (Rim Exit Devices)

A. Provide for use with type of locks shown on hardware schedule.

B. Products to be certified and listed by the following:
   1. ANSI/BHMA A156.31 Electric Strikes and Frame Mounted Actuators Grade 1.

2. UL Tested 1500 lb. static strength.
3. UL listed for Fire Doors and Frames where applicable.
4. UL 1034 Burglary Resistance.
5. UL 10C.3H fire-rated, 4’ x 8’ door.

C. Material and Design:
1. To accept up to 1” pullman style latch bolt.
2. Field selectable, Fail Safe or Fail Secure.
3. Auto sensing voltage 11 through 28 volts A/C or D/C.

D. Acceptable Manufacturers:
1. Hager Companies
2. Securitron
3. Trine

2.09 HEAVY DUTY MORTISE LOCKS AND LATCHES

A. Locks and latches of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Product to be certified and listed by following:
1. ANSI/BHMA A156.13 Series 1000 Certified to Grade 1 for Operational and Security.
2. UL/cUL Labeled and listed up to 3 hours for single doors up to 48” in width and up to 96” in height.
3. UL10C/UBC 7-2 Positive Pressure Rated.
4. ICC/ANSI A117.1.

C. Lock and latch function numbers and descriptions of manufacturer’s series as listed in hardware sets.

D. Material and Design:
1. Lock cases from fully wrapped, 12-gauge steel, zinc dichromate for corrosion resistance.
2. Non-handed, field reversible without opening lock case.
3. Break-away spindles to prevent unlocking during forced entry or vandalism.
4. Levers, zinc cast, forged brass or stainless steel and plated to match finish designation in hardware sets.
5. Escutcheons, of solid brass or stainless-steel material.
6. Armor fronts, self-adjusting to accommodate a square edge door or a standard 1/8” beveled edge door.

E. Latch and Strike:
1. Stainless steel latch bolt with minimum of 3/4” throw and deadlocking for keyed and exterior functions.
2. Strike is to fit a standard ANSI A115 prep measuring 1-1/4” x 4-7/8” with proper lip length to protect surrounding trim.
3. Deadbolts to be 1-3/4” total length with a minimum of a 1” throw and 3/4” internal engagement when fully extended and made of stainless-steel material.

F. Options:
1. Doors required lead line protection – provide locks with 1-16” lead applied to outside case of lock.
2. Provide knurled levers on entry side of doors that are potentially dangerous to visually impaired persons.

G. Electrified Locks
   1. Fail-Safe (power lock): Outside trim is locked when power is applied and unlocked when power is removed. Lockset will unlock in the event of a power failure (EL).
   2. Fail-Secure (power unlock): Outside trim is locked when there is no power and unlocked when power is applied. Lockset will be locked in the event of a power failure (EU).
   3. Latch bolt monitoring: Single switch SPDT mounted inside lockset monitors full extension of latch bolt (LM).
   4. Door Position Monitor: Single switch SPDT reed magnetic switch mounted inside lockset monitors whether door is fully closed (DPM).
   5. Request to Exit: Monitors inside lever rotation (RX).

H. Acceptable Manufacturers:
   1. Hager Companies
   2. Schlage

2.10 MORTISE DEADBOLTS

A. Mortise deadbolts of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer to be certified by the following:
   1. ANSI/BHMA A156.13 Series 2000 Grade 1 Operational and Security.
   2. UL/cUL listed for functions up to 3 hours for “A” label.
   3. UL10C/UBC 7-2 Positive Pressure Rated.
   4. ADA – Thumb turn.

C. Deadbolt function numbers and descriptions of manufacturer’s series as listed in hardware sets.

D. Material and Design:
   1. Latch bolt projection 1” throw.
   2. Case steel, zinc dichromate.
   3. Armor front 5-9/16”. Case dimension 4-5/16” x 3-9/16’ x 1”.

E. Acceptable Manufacturers:
   1. Hager Companies
   2. Schlage

2.11 EXIT DEVICES

A. Exit Devices of one manufacturer as listed for continuity of design and consideration of warranty. Touchpad type finish to match balance of door hardware.

B. Standards: Manufacturer to be certified and/or listed by the following:
   1. BHMA Certified ANSI A156.3 Grade 1.
   2. UL/cUL Listed for up to 3 hours for “A” labeled doors.
   3. UL10C/UBC 7-2 Positive Pressure Rated.
   4. UL10B Neutral Pressure Rated.
   5. UL 305 Listed for Panic Hardware.

C. Material and Design:
   1. Provide exit devices with actuators that extend a minimum of one-half of door width.
   2. Where trim is indicated in hardware sets provide the lever design to match design of lock levers.
   3. Exit device to mount flush with door.

4. Latch bolts:
   a. Rim device – 3/4” throw, Pullman type with automatic dead-latching, stainless steel
   b. Surface vertical rod device – Top 1/2” throw, Pullman type with automatic dead-latching, stainless steel. Bottom 1/2” throw, Pullman type, held retracted during door swing, stainless steel.
5. Fasteners: Wood screws, machine screws, and thru bolts.

D. Lock and Latch Functions: Function numbers and descriptions of manufacturer’s series and lever styles indicated in door hardware sets.

E. Acceptable Manufactures:
1. Hager Companies
2. Von Duprin

F. Electric Modifications:
1. Motorized Latch Retraction (MLR): An electric motor retracts the latch bolt for momentary or maintained periods of time.
2. Provide Request to Exit (REX) switches as scheduled.
3. Electrified Trim: Outside trim locked (EL) or unlocked (EU) by electric current.

2.12 CYLINDERS AND KEYING

A. Cylinders of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:
1. Auxiliary Locks: ANSI/BHMA A156.5

C. Cylinders:
1. Provide cylinders matched to the types required for hardware that has a locking function and for keyed electronic functions. Furnish with appropriate collars, cams, and tailpieces to fit and operate associated hardware. Stacking collars is not acceptable, a single collar of proper size is required.
2. Manufacturer’s standard tumbler type six-pin conventional cylinder.
3. Provide concealed key control (CKC) at cylinder by stamping or permanently marking the keyset symbol in a location on the cylinder that is concealed when installed.

D. Keying:
1. Owner provided cylinders keyed into Owner’s existing key system.
2. Provide a bitting list to Owner of combinations as established and expand to twenty-five percent for future use or as directed by Owner.
   a. Include all the keysets and bittings of the original key system creating one clean version of the entire key system.
3. Keys to be shipped directly to the Owner’s Representative as established during the keying conference.
   a. Package the keys in individual envelopes, grouped by keyset symbol, and label envelopes with project name, factory registry number, and keyset symbol.
4. Stamp large bow key blanks with visual key control (keyset symbol) and “Do Not Duplicate”.
5. Provide keyed alike cylinders to be used for construction cylinders.

E. Acceptable Manufacturers:
1. Corbin Russwin

2.13 PUSH/PULL PLATES AND BARS

A. Push/Pull plates and bars of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer to be certified by the following:
   1. Architectural Door Trim: ANSI/BHMA A156.6.
   2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).

C. Push plates: .050” thick, square corner and beveled edges with countersunk screw holes. Width and height as stated in hardware sets.

D. Pull Plates: .050” thick, square corner and beveled edges. Width and height as stated in hardware sets, 3/4” diameter pull, with clearance of 2-1/2” from face of door.

E. Push Pull Bar Sets: 1” round bar stock with 2 –1/2” clearances from face of door. Offset 3”, 90-degree standard. Center to center size should be door width less 1 stile width.

F. Pull Bar Sets: 1” round bar stock with 2 –1/2” clearances from face of door.

G. Acceptable Manufacturers:
   1. Hager Companies
   2. Burns Manufacturing
   3. Don Jo

2.14 CLOSERS

A. Closers of one manufacturer as listed for continuity of design and consideration of warranty, unless otherwise indicated on hardware schedule, comply with manufacturer’s recommendations for size of closer, depending on width of door, frequency of use, atmospheric pressure, ADAAG requirement, and fire rating.

B. Standards: Manufacturer to be certified and or listed by the following:
   1. BHMA Certified ANSI A156.4 Grade 1.
   2. ADA Complaint ANSI A117.1.
   3. UL/cUL Listed up to 3 hours.
   4. UL10C Positive Pressure Rated.
   5. UL10B Neutral Pressure Rated.

C. Material and Design:
   1. Provide cast iron non-handed bodies with full plastic covers.
   2. Closers will have separated staked adjustable valve screws for latch speed, sweep speed, and backcheck.
   3. Provide Tri-Pack arms and brackets for regular arm, top jamb, and parallel arm mounting.
   4. One-piece seamless steel spring tube sealed in hydraulic fluid.
   5. Double heat-treated steel tempered springs.
   6. Precision-machined heat-treated steel piston.
   7. Triple heat-treated steel spindle.
   8. Full rack and pinion operation.

D. Mounting:
   1. Out-swing doors use surface parallel arm mount closers except where noted on hardware schedule.
   2. In-swing doors use surface regular arm mount closers except where noted on hardware schedule.

3. Provide brackets and shoe supports for aluminum doors and frames to mount fifth screw.
4. Furnish drop plates where top rail conditions on door do not allow for mounting of closer and where backside of closer is exposed through glass.

E. Size closers in compliance with requirements for accessibility (ADAAG). Comply with following maximum opening force requirements.
1. Interior hinged openings: 5.0 lbs.
2. Fire-rated and exterior openings use minimum opening force allowable by authority having jurisdiction.

F. Fasteners: Provide self-reaming, self-tapping wood and machine screws, and sex nuts and bolts for each closer.

G. Acceptable manufacturers:
1. Hager Companies
2. LCN

2.15 LOW ENERGY POWER OPERATORS

A. Low energy power operators of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:
1. Power Assist and Low Energy Power Operated Doors: ANSI/BHMA A156.19.
2. ADA Complaint ANSI A117.1.

C. Materials and Design:
1. Self-contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for proper operation, switching and control of door up to 350 lbs. and include time delay for normal cycle.
2. On pairs of doors, door to be opened manually without the other door opening.
3. Operates as a mechanical closer if power is disconnected. Forces consistent with ANSI A117.1 and ANSI A156.19.
4. Provide delay switches for motor activation, exit device latch retraction interfacing, and hold open times. Hold open times to be adjustable from 1 second to continuous seconds.
5. Adjustable vestibule sequencing input for operation of two or more units. Specify 2-659-0240.
6. Adjustable powered swing degree from 80 degrees to 110 degrees.
7. Integral obstruction detection for closing and opening cycle.
8. Adjustable built-in stop set from 80 degrees maximum to 180 degrees manual swing.
9. When in “blow open” operation for smoke ventilation, operator will stay in the open position when loss of power.
10. Boost to close selectable on/off switch.

D. Signage: Provide signage in according to the requirements of ANSI/BHMA A156.19.

E. Acceptable Manufacturers:
1. Hager Companies
2. LCN
3. Norton

F. Actuators:
1. Opening cycle activated by pressing switches with international symbol of accessibility and “PUSH TO OPEN” engraved on faceplate.

2. Switches installed in standard 2-gang electrical wall box and placed in a location in compliance with ANSI A117.1.
3. Wireless actuators optional.
4. Provide bollards as required where a suitable wall mount is not possible.

G. Acceptable Manufacturers:
1. Hager Companies
2. MS Sedco
3. Security Door Controls

2.16 PROTECTIVE TRIM

A. Protective trim of one manufacturer as listed for continuity of design and consideration of warranty.

B. Size of protection plate: single doors, size two inches less door width (LDW) on push side of door, and one inch less door width on pull side of door. For pairs of doors, size one inch less door width (LDW) on push side of door, and 1/2 inch on pull side of door. Adjust sizes to accommodate accompanying hardware, such as, edge guards, astragals, and others.
1. Kick Plates 10” high or sized to door bottom rail height.
2. Mop Plates 4” high.
3. Armor Plates 36” high.

C. Products to be certified and listed by the following:
1. Architectural Door Trim: ANSI/BHMA A156.6.
2. UL.

D. Material and Design:
1. 0.050” gage stainless steel.
2. Corners square, polishing lines, or dominant direction of surface pattern so they run across door width of plate.
3. Bevel top, bottom, and sides uniformly leaving no sharp edges.
4. Countersink holes for screws. Space screw holes so they are no more than eight inches CTC, along a centerline not over 1/2” in from edge around plate. End screws maximum of 0.53” from corners.

E. UL label stamp required on protection plates when top of plate is more than 16 inches above bottom of door on fire rated openings. Verify door manufacturer’s UL listing for maximum height and width of protection plate to be used.

F. Acceptable Manufacturers:

1. Hager Companies
2. Burns Manufacturing
3. Don Jo

2.17 STOPS AND HOLDERS

A. Stops and holders of one manufacturer as listed for continuity of design and consideration of warranty.

B. Wall Stops: Provide door stops wherever necessary to prevent door or hardware from striking an adjacent partition or obstruction. Provide wall stops when possible. Door stops and holders

mounted in concrete floor or masonry walls have stainless steel machine screws and lead expansion shields.

C. Products to be certified and listed by the following:
   1. Auxiliary Hardware: ANSI/BHMA A156.16.

D. Acceptable Manufacturers:
   1. Hager Companies
   2. Burns Manufacturing
   3. Don Jo

E. Overhead Stops and Holders: Provide overhead stops and holders for doors that open against equipment, casework sidelights and other objects that would make wall stops/holders and floor stops/holders inappropriate. Provide sex bolt attachments for mineral core wood door applications.

F. Products to be certified and listed by the following:
   1. Overhead Stops and Holders: ANSI/BHMA A156.8 Grade 1.

G. Acceptable Manufacturers:
   1. Hager Companies
   2. ABH
   3. Glynn Johnson

2.18 ELECTROMAGNETIC HOLDERS

A. Electromagnetic holders of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:
   1. ANSI A156.15 Grade 1.
   2. UL/ULC Listed.
   3. California State Fire Marshall listed (CSFM).
   4. City of New York MEA approved.

C. Material and Design:
   1. Provide electromagnetic holders where self-closing fire doors and smoke barrier doors are required to be held open. Electromagnetic holders to be fail-safe: when electrical current is interrupted, doors release to close automatically. Holding force 25-40 lbs.

D. Acceptable Manufacturers:
   1. Hager Companies
   2. ABH
   3. LCN

2.19 MODULAR ACCESS CONTROL POWER SUPPLIES

A. Power supplies of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:
   1. UL Listed.

C. Design:

1. Use with modular access control systems.
2. Field selectable filtered and regulated 12 VDC or 24 VDC constant voltage.
3. 1, 2, 4, and 6 AMP load capacities. Match the power supply amperage to the total load of the opening /system plus an additional thirty percent to cover line drop, as well as possible expansion.
4. Circuit breaker protected AC input voltage; secondary output PTC protected.
5. Fire alarm input provides simultaneous release of fail-safe locks and holders.
6. Interface relay.
7. LED status indicators provide information regarding AC input, DC output, and battery backup status.
8. Separate inputs for activation switch on entry and egress and ingress side of opening.
9. 5-amp hour battery backup.
10. Input 115 VAC (230 VAC optional).
11. Optional dual 12 VDC or 24 VDC output.
12. Optional power supply monitor module to monitor power supply status, A/C power, and D/C output and battery status.
13. Boxes and enclosures containing security system components or cabling, which are easily accessible to employees or to the public, shall be provided with a keyed lock. Boxes above ceiling level in occupied areas of the building will not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public will be covered with a suitable cover plate and secured with tamper-proof screws.

D. Include optional modules as required to properly interface, control, and sequence the hardware with the access control system.

A. Acceptable Manufacturers:
   1. Hager Companies

2.20 THRESHOLDS

A. Thresholds of one manufacturer as listed for continuity of design and consideration of warranty.

B. Set thresholds for exterior and acoustical openings in full bed of sealant with lead expansion shields and stainless-steel machine screws complying with requirements specified in Division 07 Section “Joint Sealants: Notched in field to fit frame by hardware installer. Refer to Drawings for special details.

C. Standards: Manufacturer to be certified by the following:
   1. Thresholds: ANSI/BHMA A156.21.
   2. American with Disabilities Act Accessibility Guidelines (ADAAG).

D. Acceptable Manufacturers:
   1. Hager Companies
   2. National Guard Products
   3. Pemko

2.21 DOOR GASKETING AND WEATHERSTRIP

A. Door gasketing and weatherstrip of one manufacturer as listed for continuity of design and consideration of warranty.

B. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing where indicated on hardware schedule. Provide noncorrosive fasteners for exterior applications.

1. Perimeter gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting stile gasketing: Fasten to meeting stiles, forming seal when doors are in closed position.
3. Door bottoms: Apply to bottom of door, forming seal with threshold or floor when door is in closed position.
4. Sound Gasketing: Cutting or notching for stop mounted hardware not permitted.
5. Drip Guard: Apply to exterior face of frame header. Lip length to extend 4” beyond width of door.

C. Products to be certified and listed by the following:
1. Door Gasketing and Edge Seal Systems: ANSI/BHMA A156.22.
2. BHMA certified for door sweeps, automatic door bottoms, and adhesive applied gasketing.

D. Smoke-Labeled Gasketing: Comply with NFPA 105 listed, labeled, and acceptable to Authorities Having Jurisdiction, for smoke control indicated.
1. Provide smoke-labeled gasketing on 20-minute rated doors and on smoke rated doors.

E. Fire-Rated Gasketing: Comply with NFPA 80 listed, labeled, and acceptable to Authorities Having Jurisdiction, for fire ratings indicated.

F. Refer to Section 08 1416 Wood Doors for Category A or Category B. Comply with UBC 7-2 and UL10C positive pressure where frame applied intumescent seals are required.

E. Acceptable Manufacturers:
1. Hager Companies
2. National Guard Products
3. Pemko

2.22 SILENCERS

A. Where smoke, light, or weather seal are not required, provide three silencers per single door frame, two per double door frame and four per Dutch door frame.

B. Products to be certified and listed by the following:
1. Auxiliary Hardware: ANSI/BHMA A156.16

A. Acceptable Manufacturers:
1. Hager Companies
2. Burns Manufacturing
3. Don Jo

2.23 KEY CABINET

A. Provide key cabinet; surface mounted to wall.

B. Key control system:
1. Include two sets of key tags, hooks, labels, and envelopes.
2. Contain system in metal cabinet with baked enamel finish.
3. Capacity will be able to hold actual quantities of keys, plus 50 percent.
4. Provide tools, instruction sheets, and accessories required to complete installation.

C. Acceptable Manufacturers:
   1. Lund Equipment
   2. Telkee Incorporated
   3. Key Control

2.24 FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if within range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved samples.

B. Comply with base material and finish requirements indicated by ANSI/BHMA A156.18 designations in hardware schedule.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine doors and frames, with installers present, for compliance with requirements for installation tolerances, labeled fire-rated construction, wall and floor construction, and other conditions affecting performance.

B. Where hardware will be installed directly on walls inspect applications for blocking material of sufficient type and size for hardware.

C. Examine roughing-in and cabling for electrical power systems to verify actual locations of wiring connections and wiring supplied matches the requirements as described in the wiring diagrams before electrified door hardware installation.

D. Where existing products will be reused, examine existing door and frame sizes, preps, swings, ratings, and compare to the specified hardware for compatibility and functionality. The hardware set specified should act as guide for design and function. Provide filler plates as needed to fill and repair existing materials. Test any existing to remain hardware for functionality and visually inspect for damage. Note any defective or damaged products as well as noting any code deficiencies and submit issues and estimated costs for direction of how to proceed with repair or replacement.

E. Notify Architect via a prepared written report and endorsed by installer of any discrepancies between the door schedule, door types, drawings, and scheduled hardware. List conditions detrimental to application, to the proper and timely completion of the work and performance of the hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 INSTALLATION

A. Install hardware using manufacturers' recommended fasteners and installation instructions, at height locations and clearance tolerances that comply with:
   1. NFPA 80
   2. NFPA 105
   3. ICC/ANSI A117.1
   4. DHI Publication – Installation Guide for Doors and Hardware
   5. Approved shop drawings
   6. Approved hardware schedule

B. Install soffit mounted gaskets prior to other soffit mounted hardware ensuring a continuous seal around the perimeter of the opening without cutting or notching.

C. Locate surface mounted door closers on stairwell side of stair doors, interior side of exterior openings, or on the room side of openings, unless it is a sterile room.

D. Locate wall mounted bumper to contact the operating trim. Verify that pushbuttons of locksets do not contact the stop and inadvertently lock the door.

E. Mount armor, mop, and kick plates flush with the bottom of the door and centered horizontally on the door.

F. Notch thresholds with no larger than a 1/32-inch gap matching the frame profile. Set in a full bed of sealant complying with requirements specified in Division 07 Section “Joint Sealants” forming a tight seal between threshold and mounting surface. Caulk and seal the entire perimeter to prevent water leakage. Remove excess sealants immediately and clean the area thoroughly.

G. Do not install surface mounted items until finishes have been completed on substrates involved. Set unit level, plumb and true to line location.

H. Locate power supplies and junction boxes as directed and verified in the low-voltage coordination meeting.

I. Perform final connections of the system components to match the approved operational narratives. Use cable markers to label wires at each termination or end to match the final wiring diagrams. Terminate wiring in accordance with the manufacturer’s recommendations. Where quick-connects are seated correctly. Provide wire ties and adhesive pads to secure and organize wires in enclosures. Outside of enclosures seal terminations in waterproof connectors. Include record drawings of the point-point and the elevations in a plastic sleeve attached to the inside cover of the power supply/junction box enclosure for the Owner’s use.

3.03 FIELD QUALITY CONTROL

A. Schedule a final walk through to inspect hardware installation ten (10) business days before final acceptance of the Owner. Visually inspect for proper fasteners and verify that doors open, close, latch properly, and that openings are installed to meet NFPA 80 and ANSI A117.1 requirements. Correct deficiencies, including missing hardware immediately. Provide a written report detailing discrepancies of each opening within five (5) business days of the walk through.

B. Prior to receiving certificate of occupancy have doors inspected by a Certified Fire and Egress Door Assembly Inspector (CFDAI), as certified by Intertek (ITS), submit a written report to the Owner and Contractor. Doors failing inspection must be adjusted, modified, or replaced to be within appropriate code requirements without delay.

C. Test the functionality of electrified openings upon completion of the installation in accordance with the description of operation and the Owner’s intent under the supervision of a factory authorized representative and an Owner’s representative, verify that all features of the software are working correctly, including interfaces with any associated trades. Document the result of all tests and provide these results to the Owner and correct immediately.

3.04 ADJUSTMENT, CLEANING, AND DEMONSTRATING

A. Prior to final adjustments, the HVAC system must be completed and balanced. Test that all openings meet ANSI A117.1 for closer opening pressure, closing speed, latching, and hardware

operating forces. Replace items that cannot be adjusted to operate freely and smoothly or as intended for application.

B. Prior to final walk-through inspection, clean adjacent surfaces soiled by hardware installation. Clean finish hardware per manufacturer's instructions after final adjustments have been made. Remove all protection and replace items that cannot be cleaned to manufacturer's level of finish quality.

C. Demonstration and training will be conducted as per the following sessions. All sessions will be recorded and turned over to the Owner for future use.
   1. Hardware Maintenance: Conduct a training class for building maintenance personnel demonstrating the adjustment, operation, and maintenance of mechanical and electrified hardware. Special tools for finish hardware to be turned over and demonstrated usage at the meeting.
   2. Key control system: Train the Owner's designated representative on the key control system demonstrating the permanent file keys, duplicate loaner keys, key receipts, key envelopes, key change identification sheets, bitting lists, tags, and labels. When key management software is provided training will be provided for the setup and usage of the software.
   3. Access control: Demonstrate the management and programming of the access control system including the following, but not limited to:
      a. System administration personnel to manage the LAN and databases including updating, maintaining, and backing up the system and database software.
      b. Instruct on all software features and programming for managing the credentials, users, access points, time zones, alarms and events, door monitoring, audit trails, and time schedules.

3.05 PROTECTION

A. Leave manufacturer's protective film intact and, protect exit devices, locks, and surface mounted hardware with kraft paper or bubble wrap. Cover fire labels at painted products that bear a label with magnetic or masking tape. Keep protection in place until time of final cleaning and adjustment.

3.06 HARDWARE SET SCHEDULE

A. Door hardware items have been placed in sets which are intended to be a guide of design, grade, quality, function, operation, and performance.
   1. Review products that may require mounting accessories to meet door, frame, and swing conditions as these final details vary from manufacturer to manufacturer and provide as required.
   2. Where additional items of hardware are required for completion of the Work, a written statement of such omission, error, or other discrepancy is required to be submitted to the Architect, prior to bid date for clarification via an addendum.
   3. Abbreviations listed below do not appear in the manufacturer's literature, for any other abbreviations refer to manufacturer's literature.:
      a. LDW = Less than Door Width
      b. LAR = Length as Required
      c. QTY = Quantity
      d. CTC = Centerline to Centerline
      e. BTB = Back-to-Back mounting

3.07 HARDWARE SCHEDULE

Manufacturer List

Code	Name
AB	ABH Manufacturing Inc.
BYOT	By Others
HA	Hager
HS	HES
SPCL	Special-Lite

Hardware Sets

Set #01.00

Doors: 101A

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Rim Cylinder(s)	3901 KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Offset Door Pul(s)	H 12J	US32D	HA
1	Single Operator	8318 PUSH 36"	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Actuator	8228-02H/00 / 8228-03H/02	US32D	HA
1	Vestibule Actuator	8228-05H/00	US32D	HA
3	Transmitter	82TX		HA
1	Receiver	82RX		HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Sweep(s)	750S N x LAR	CLR	HA
1	Threshold	412S x LAR	MIL	HA
1	Power Supply	2909		HA
1	Access Control Reader	By Security Provider		BYOT

The vestibule actuator services the automatic operators at 101A & 101C
The power supply services 101A & 101.

Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latches on 101A & 101 and activates the outsside actuator.
Depressing the actuator cycles the automatic operator.
Free egress at all time by depressing the exit device rail retracts the latch or by depressing the actuator retracts the latch and cycles the automatic operator.

Set #01.01

Doors: 101

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Offset Door Pul(s)	H 12J	US32D	HA
1	Closer	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Sweep(s)	750S N x LAR	CLR	HA
1	Threshold	412S x LAR	MIL	HA

Set #01.01

Top Jamb mount the door closer.
Power supply specified in HW Set #01.00.

Operation:
Door normally closed and locked.
An access control time schedule or valid credential a the reader on opening 101A retracts the latch for entry.
Free egress at all time.

Set #02.00

Doors: 101C

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Rim Cylinder(s)	3901 KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Offset Door Pul(s)	H 12J	US32D	HA
1	Single Operator	8318 PUSH 36"	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Actuator	8228-02H/00 / 8228-03H/02	US32D	HA
1	Transmitter	82TX		HA
1	Receiver	82RX		HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Sweep(s)	750S N x LAR	CLR	HA
1	Power Supply	2909		HA
1	Access Control Reader	By Security Provider		BYOT

The vestibule actuator is specified in HW Set #
The power supply services 101C & 101B.

Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latches on 101C & 101B and activates the vestibule actuator.
Depressing the actuator cycles the automatic operator.
Free egress at all time by depressing the exit device rail retracts the latch or by depressing the actuator retracts the latch and cycles the automatic operator.

Set #02.01

Doors: 101B

Set #02.01

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Offset Door Pul(s)	H 12J	US32D	HA
1	Closer	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Sweep(s)	750S N x LAR	CLR	HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Top Jamb mount the door closer.
Power supply specified in HW Set #02.00

Operation:
Door normally closed and locked.
An access control time schedule or valid credential a the reader on opening 101C retracts the latch for entry.
Free egress at all time.

Set #02.02

Doors: 110C, C1

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Storeroom Lockset	3880 ESC WTN KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Electric Strike	4500C	630	HS
1	Closer	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2908		HA
1	Access Control Reader	By Security Provider		BYOT

Top jamb mount the door closer.

Operation:
Door normally closed and locked.
A valid credential at the reader releases the electric strike for entry.
Free egeress at all time.

Set #02.50

Doors: 152

2	Continuous Hinge(s)	780-112HD	CLR	HA
2	Power Transfer(s)	2-679-0623	ALM	HA
2	Exit Device(s)	4501 LBR FEC	US26D	HA
2	Exit Device Trim	45CE WTN	US26D	HA
2	Mortise Cylinder(s)	3902 KA	US26D	HA
2	Permanent Cylinder	By Owner		BYOT
2	Closer	5100	ALM	HA
2	Drop Plate(s)	5110	ALM	HA
2	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #03.00

Doors: 103, 104

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Passage Set	3810 ESC WTN	US26D	HA
1	Closer	5100	ALM	HA
1	Convex Wall Stop	232W/236W (as req'd)	US32D	HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #04.00

Doors: 102, 110A, 110B

Set #04.00

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Exit Device(s)	4501 RIM FEC	US32D	HA
1	Closer(s)	5100 HDCS	ALM	HA
1	Threshold	412S x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #05.00

Doors: 102B

1	Storeroom Lockset	3880 ESC WTN KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Electric Strike	4500C	630	HS
1	Power Supply	2908		HA
1	Access Control Reader	By Security Provider		BYOT
1	Balance of Hardware	Existing to Remain		BYOT

Provide cover plates as required to conceal any exposed door prep left from the lock replacement.
Modify the existing frame strike prep to receive the new electric strike.

Operation:
Door normally closed and locked.
A valid credential at the reader releases the electric strike for entry.
Free egress at all time.

Set #06.00

Doors: 107

3	Hinge	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 ESC WTN KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Closer	5100	ALM	HA
1	Protection Plate	190S 10" x 2" LDW CSK	US32D	HA
1	Convex Wall Stop	232W/236W (as req'd)	US32D	HA
3	Silencers	307D	GREY	HA

Set #06.01

Doors: 112

1	Storeroom Lockset	3880 ESC WTN KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Balance of Hardware	Existing to Remain		BYOT

Provide cover plates as required to conceal any exposed door prep left from the lock replacement.

Set #07.00

Doors: 137, 138, 143

3	Hinge	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Office Lockset	3850 ESC WTN KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Convex Wall Stop	232W/236W (as req'd)	US32D	HA
3	Silencers	307D	GREY	HA

Set #07.01

3	Hinge	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Office Lockset	3850 ESC WTN KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Overhead Stop(s)	7016 SRF	US32D	HA
3	Silencers	307D	GREY	HA

Set #07.02

Doors: 102C, 119A, 119B, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 134, 146A, 152A, 154

1	Office Lockset	3850 ESC WTN KA	US26D	HA
1	Permanent Cylinder	By Owner		BYOT
1	Balance of Hardware	Existing to Remain		BYOT

Provide cover plates as required to conceal any exposed door prep left from the lock replacement.

Set #08.00

Doors: 106, 109, 111

3	Hinge	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Privacy Set w/ Indicator	3896 ESC WTN	US26D	HA
1	Closer	5100	ALM	HA
1	Protection Plate	190S 10" x 2" LDW CSK	US32D	HA
1	Protection Plate	190S 4" x 1" LDW CSK	US32D	HA
1	Convex Wall Stop	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA

Set #08.01

Doors: 121B

1	Privacy Set w/ Indicator	3896 ESC WTN	US26D	HA
1	Balance of Hardware	Existing to Remain		BYOT

Provide cover plates as required to conceal any exposed door prep left from the lock replacement.

Set #09.00

Doors: 121C, 136, 147

3	Hinge	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Passage Set	3810 ESC WTN	US26D	HA
1	Convex Wall Stop	232W/236W (as req'd)	US32D	HA
3	Silencers	307D	GREY	HA

Set #09.01

Doors: 146

1	Passage Set	3810 ESC WTN	US26D	HA
1	Balance of Hardware	Existing to Remain		BYOT

Provide cover plates as required to conceal any exposed door prep left from the lock replacement.

END OF SECTION

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Monolithic glazing.
B. Insulating glass.
C. Fire rated glazing.
D. Glazing compounds.

1.02 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. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
E. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2023.
F. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants; 2019.
G. ASTM C1249 - Standard Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications; 2018 (Reapproved 2023).
H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
I. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2023.
J. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
K. ASTM C793 - Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants; 2023.
L. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
M. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
N. ASTM C1036 - Standard Specification for Flat Glass; 2021.
O. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
P. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
Q. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
R. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
S. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
T. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
U. GANA (GM) - GANA Glazing Manual; 2022.
V. GANA (SM) - GANA Sealant Manual; 2008.
W. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.
X. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
Y. IGMA TB-3001 - Guidelines for Sloped Glazing; 2001.
Z. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

AA. NFPA 251 - Standard Methods of Tests of Fire Resistance of Building Construction and Materials - 2006.
BB. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
CC. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
DD. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
EE. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data on Glazing. 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 three samples 12 by 12 inch in size for each glass type.
    1. Non-insulated types may be 4 by 4 inches in size.
E. Certificate: Certify that products of this section meet or exceed specified requirements.
F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), IGMA TM-3000, and IGMA TB-3001 for glazing installation methods.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years documented experience.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
    1. Install glazing in mockups specified in:
        a. Section 08 4313 - Aluminum-Framed Storefronts.
C. Mock-ups may remain as part of the Work.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. 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.
C. Laminated Glass: Provide a ten (10) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

D. Coated Glass: Provide a ten (10) year manufacturer warranty to include coverage for peeling, cracking, and other indications of deterioration in coating, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
   1. Guardian Glass, LLC: www.guardianglass.com.
   2. Pilkington North America Inc: www.pilkington.com.
   3. Viracon, Inc: www.viracon.com.
   4. Vitro Architectural Glass (formerly PPG Industries, Inc.): www.vitroglazings.com.

B. Low Iron Float Glass Products:
   1. Guardian Glass, LLC; UltraClear: www.guardianglass.com.
   2. Pilkington North America Inc; Optiwhite: www.pilkington.com.
   3. Vitro Architectural Glass (formerly PPG Industries, Inc.); Starphire Ultra-Clear : www.vitroglazings.com.
   4. Substitutions: Refer to Section 01 6000 - Product Requirements.

C. Laminated Glass Manufacturers:
   1. Any of the manufacturers specified for float glass.

D. Insulating Glass Manufacturers:
   1. Any of the manufacturers specified for float glass.
   2. All lites of an Insulating Glazing Unit shall be by one manufacturer. Do not mix manufacturers within IGUs.

E. Fire Rated Glass Manufacturers:
   1. McGrory Glass, Inc.: www.mcgrory.com
   2. SAFTIFIRST, a division of O'Keeffe's Inc.; www.safti.com.
   3. Schott Corporation: www.us.schott.com
   4. Technical Glass Products (TGP); www.fireglass.com.
   5. Vetrotech Saint-Gobain North America; www.vetrotech.com.
   6. Substitutions: Refer to Section 01 6000 - Product Requirements.

F. Source Limitations: Obtain Float Glass and Low Iron Float Glass from one manufacturer. Obtain Fire Rated Glass from one manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Exterior Glazing Assemblies:
   1. 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.
      a. Design Pressure: Calculated in accordance with ASCE 7 applicable codes, and as indicated on Drawings..
      b. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
         1) Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 the short side length or 1 inch, whichever is less.
      c. 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.
      d. Glass thicknesses listed are minimum.
   2. 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:
      a. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.

b. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
c. Solar Optical Properties: Comply with NFRC 300 test method.

B. Probability of Breakage: Design glass for a probability of breakage not greater than 0.008 (8 lites per 1000) for glass not more than 15 degrees from vertical.

C. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Insulating Glass:
1. Insulating Glass Certification Program: Provide insulating glass units that are certified by the Insulating Glass Certification Council (IGCC).
a. Provide permanent markings with appropriate certification label of IGCC on either the spacer or one lite of each insulated unit.

E. Safety Glazing:
1. Complies with ANSI Z97.1 and 16 CFR 1201; test requirements for Class A/Category II.
2. Markings for Safety Rated Glazing: Provide permanent markings on safety-rated glazing in compliance with applicable safety glazing standards, ICC (IBC), local building code, and authorities having jurisdiction.

F. Fire Rated Glazing:
1. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with NFPA 80, NFPA 252, NFPA 257, UL 9, UL 10B, and UL 10C.
a. Fire protection rated glazing with a 20 minute rating shall be exempt from the hose-stream test.
2. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with ASTM E119, NFPA 80, NFPA 251, NFPA 252, NFPA 257, UL 9, UL 10B, UL 10C, and UL 263.
3. Labeling: Provide permanent markings on fire rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
a. "W" Label: Meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
b. "OH" Label: Meets fire window assembly criteria including hose stream test of NFPA 257 or UL 9 fire test standards.
c. "D" Label: Meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
d. "H" Label: Meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
e. "T" Label: Meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
f. "XXX" Label - Placeholder that represents fire protection or fire resistance rating period, in minutes.
4. Accessories:
a. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with fire rated glazing and each other, and that are approved for use with fire rated glazing by testing agencies that listed and labeled fire rated glazing.

G. Glass Thickness: Indicated glass thicknesses are minimums. Provide glass that complies with performance requirements and load designs, and is not less than the thickness indicated.

H. Glass Strength:
1. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with performance requirements.

2. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with performance requirements.

I. Glass Distortion Tolerances:
1. Roller Wave: Maximum 0.003 (0.076 mm) from peak to valley within the main body of the sheet and maximum 0.008 (0.2 mm) within 10.5 inches of a leading or trailing edge.
2. Localized Warp: Maximum 0.03 inch (0.8 mm) over any 12 inch (305 mm) span, but limited to 0.31 inch (8 mm).

2.03 FLOAT GLASS

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. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
a. Glass Tints: Provide the following:
1) Color: Gray.
(a) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Solargray, or a comparable product from any of the manufacturers specified for float glass.

2.04 LAMINATED GLASS

A. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Unless otherwise indicated laminate glass shall consist of two plies of clear annealed float glass with a polyvinyl butyral interlayer.
a. Minimum Thickness of Each Glass Ply: 1/8 inch (3 mm), unless otherwise indicated.
b. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum, unless otherwise indicated.
1) Interlayer Color: Clear, unless otherwise indicated.

2.05 INSULATING GLASS

A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. General: Unless otherwise noted, Insulating Glass Unit Types shall comply with the following:
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
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.
a. Low-E Coating:
1) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc. ; Solarban 70, or a comparable product from any of the manufacturers specified for float glass.
3. Perimeter Spacer: Warm-edge spacer.
a. Manufacturer's standard low conductivity polymer, stainless steel, or hybrid material.
1) Spacer Color: Gray.
2) Spacer Width: As required for specified insulating glass unit.
3) Products:
(a) Quanex IG Systems, Inc; Super Spacer Premium Enhanced: www.quanex.com.
(b) Technoform Glass Insulation; TGI-Spacer: www.glassinsulation.us.
(c) Viracon, Inc; VTS (Viracon Thermal Spacer): www.viracon.com.
(d) Vitro Architectural Glass (Formerly PPG); Intercept Spacer System: www.vitroglazings.com.
(e) Substitutions: Refer to Section 01 6000 - Product Requirements.
4. Edge Seal:

a. Dual-Sealed System: Provide polyisobutylene or acrylic adhesive or spacer manufacturer's standard sealant as primary seal applied between spacer and glass panes, and butyl sealant as secondary seal applied around perimeter.
b. Color: Black.

5. Purge interpane space with dry air, hermetically sealed.

2.06 FIRE RATED GLASS

A. Fire-Protection-Rated Glazing - 20 Minute: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.
1. Glass Type: Specialty tempered float glass.
2. Meet safety glazing requirements indicated in performance requirements.
3. Meet fire door assembly criteria for a "D" label as indicated in the performance requirements.
4. Glazing Method: As required for fire rating.
5. Fire-Rating: 20 minutes.
6. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
a. McGrory Glass; FireDefend 20: www.mcgrory.com
b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I: www.safti.com.
c. Technical Glass Products; Fireglass20: www.fireglass.come.
d. Vetrotech Saint-Gobain North America; Pyroswiss 20: www.vetrotechusa.com.

B. Fire-Protection-Rated Glazing For Door Lites: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.
1. Glass Type: Specialty tempered float glass.
2. Meet safety glazing requirements indicated in performance requirements.
3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
4. Glazing Method: As required for fire rating.
5. Fire-Rating: As indicated.
6. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite X: www.safti.com.

C. Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.
1. Glass Type: Laminated ceramic glass.
a. Neutral color, free of amber tint.
2. Meet safety glazing requirements indicated in performance requirements.
3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
4. Meet fire window assembly criteria for "W" and "OH" labels as indicated in the performance requirements.
5. Glazing Method: As required for fire rating.
6. Fire-Rating: As indicated.
7. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
a. McGrory Glass; Pyran Platinum L: www.mcgrory.com
b. SCHOTT North America Inc; Pyran Platinum L: www.us.schott.com.
c. Technical Glass Products; FireLite Plus: www.fireglass.come.
d. Vetrotech Saint-Gobain North America; Keralite L: www.vetrotechusa.com.

D. Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period.
   1. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.
   2. Meet safety glazing requirements indicated in performance requirements.
   3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
   4. Meet fire window assembly criteria for "W" and "OH" labels as indicated in the performance requirements.
   5. Meet temperature rise criteria for "T" label as indicated in the performance requirements.
   6. Glazing Method: As required for fire rating.
   7. Fire-Rating: As indicated.
   8. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
      a. McGrory Glass; AGC Pyrobel: www.mcgrory.com
      b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL : www.safti.com/sle.
      c. Technical Glass Products; Pilkington Pyrostop : www.fireglass.com.
      d. Vetrotech Saint-Gobain North America; Contraflam : www.vetrotechusa.com

2.07 GLAZING COMPOUNDS

A. Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, butyl sealant.
   1. Product:
      a. Pecora Corp.; BC-158: www.pecora.com.
      b. Tremco, Inc.; Butyl Sealant: www.tremcosealants.com.
      c. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. General Glazing Silicone Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25 or 50, Use NT.
   1. Products:
      a. Dow Corning Corporation; 899 Silicone Glazing Sealant: www.dowcorning.com.
      b. GE/Momentive Performance Materials, Inc: SCS2800 SilGlaz II: www.siliconeforbuilding.com
      c. Pecora Corporation: 896: www.pecora.com.
      d. Tremco, Inc.: Spectrem 2: www.tremcosealants.com.
      e. Substitutions: Refer to Section 01 6000 - Product Requirements.
   2. Color: Black.

C. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
   1. SSG adhesive in compliance with ASTM C920; Type S - Single-component, Grade NS, Class 25, Use NT, G, and A.
   2. Ultimate Tensile Strength: Minimum of 50 psi as determined by test method ASTM C1135 under the following conditions.
      a. Exposure to air temperatures of 190 degrees F and minus 20 degrees F.
      b. Water immersion for seven (7) days, minimum.
      c. Exposure to weathering for 5,000 hours, minimum.
   3. Sealant Design Tensile Strength: 20 psi, maximum.
   4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.
   5. Color: Black.
   6. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.
   7. Products:
      a. Dow Corning Corporation; 995 Structural Glazing Sealant: www.dowcorning.com .
      b. GE/Momentive Performance Materials, Inc: SSG4000 UltraGlaze: www.siliconeforbuilding.com.

c. Pecora Corporation: 895NST: www.pecora.com.
d. Sika; SikaSil SG-20: www.sika.com.
e. Tremco, Inc.: Proglaze SSG: www.tremcosealants.com.
f. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.08 ACCESSORIES

A. Setting Blocks: EPDM or neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
B. Spacer Shims: EPDM or neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch 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; 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.
D. Glazing Gaskets and Splines: Resilient EPDM or polyvinyl chloride extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
E. Glazing Clips: Manufacturer's standard type.

2.09 VISION LITE KITS FOR FIRE RATED DOOR GLAZING

A. At Contractor's option, instead of glass stops provided by door manufacturers, provide fire rated glass manufacturer’s standard vision lite kits for installing fire-rated glass in doors.
1. Moldings: Minimum 20 gage, 0.036 inch, thick steel.
2. Profile: Manufacturer’s standard profiles.
3. Door Lite Sizes: As indicated on Drawings.
4. Fire Ratings: As indicated on Drawings.
5. Finish: Manufacturer’s standard primer.
6. Basis-of-Design Product: Provide SAFTIFIRST, a division of O'Keeffe's Inc.; Vision Kits: www.safti.com, or a comparable product from any of the manufacturers specified for fire-rated glass.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
C. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Use one or more of the specified glazing methods as recommended by GANA, glass manufacturer, and installer, and as required to comply with performance requirements.
C. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
D. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
E. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
F. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
G. 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.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
B. Cut glazing tape or spline to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
F. Carefully trim protruding tape with knife.

3.06 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.
B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
E. Place glazing tape on free perimeter of glazing in same manner described above.
F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
G. Carefully trim protruding tape with knife.

3.07 INSTALLATION - STRUCTURAL SILICONE GLAZING

A. See Section 08 4413 for wall framing assembly requirements.
B. Application - Field Glazed: Follow basic guidelines of structural silicone glazing for glazing application.
    1. Two-Sided Structural: Glass structurally adhered to vertical mullions with horizontal sides captured in glazing pockets.

C. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.
D. Provide only structural silicone sealant, tested and manufactured for structural glazing.
E. Prevent structural silicone sealant from blocking weep systems.

3.08 INSTALLATION - FIRE-RATED GLAZING UNITS

A. Install fire-rated glazing in compliance with written instructions of fire-rated glazing manufacturer as required to maintain specified fire rating.
   1. Use glazing method and materials as indicated by the fire rated glazing manufacturer as required to maintain specified fire-rating.

3.09 INSTALLATION - PLASTIC FILM

A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
B. Place without air bubbles, creases or visible distortion.
C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

3.10 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.

3.11 PROTECTION

A. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

3.12 GLASS SCHEDULE

A. GL-2: Clear monolithic safety glass.
   1. Clear fully tempered safety glass.
   2. Minimum Thickness: 1/4 inch (6 mm).
   3. Safety glazing required.
B. SSGL-1: Clear heat-strengthened laminated security glass.
   1. Clear laminated safety glass.
   2. PVB Interlayer Thickness: .090.
   3. PVB Interlayer Color: Clear.
   4. Minimum Thickness: 9/16 inch (14 mm).
   5. Safety glazing required.
C. SSGL-2 Low-E Coated, Tinted heat-strethen laminated security insulating glass.
   1. Overall Unit Thickness: 1-1/16 inch.
   2. Outdoor Lite: Tinted fully tempered float glass.
      a. Low-E Coating: On 2nd surface.
      b. Tint: Gray.
   3. Airspace:
      a. Width: 1/2 inch.
      b. Interspace Content: Air.
   4. Indoor Lite: Clear heat-strengthen laminated float glass.
      a. PVB Interlayer Thickness: .090.
      b. PVB Interlayer Color: Clear.
      c. Minimum Thickness: 7/16 inch (6 mm).
   5. Performance:
      a. Winter Nighttime U-Factor: 0.29 maximum.

b. Visible Light Transmittance: 64 percent minimum.
c. Solar Heat Gain Coefficient: 0.27 maximum.

D. SSGL-3: Tinted heat-strengthened laminated security glass.
1. Clear laminated safety glass.
2. PVB Interlayer Thickness: .090.
3. PVB Interlayer Color: Clear.
4. Minimum Thickness: 9/16 inch (14 mm).
5. Safety glazing required.
6. Tint: Gray

END OF SECTION

SECTION 08 8300 - MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass with safety backing.

1.02 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 C1036 - Standard Specification for Flat Glass; 2021.
D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
E. GANA (GM) - GANA Glazing Manual; 2022.
F. GANA (SM) - GANA Sealant Manual; 2008.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.05 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
   1. Thickness: 1/4 inch.
   2. Edges: Flat polished, sealed.
   3. Size: As indicated on drawings.

2.02 FRAMING

A. Mirror Clips: Top adjustable mounting clips and fixed bottom clips without an airspace behind mirror.
   1. Exposed Face: 1/4 inches.
   2. Finish: Nickel plated.
   3. Products:
      a. C.R. Laurence Co., Inc.; Bishop Mirror Clips, www.crlaurence.com.
         1) 2-Piece Top Clip: Model SW5232/SW5233.
         2) Bottom Clip: SW6003
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Safety Backing: Pressure-sensitive adhesive coated film with embedded woven scrim.
   1. Complies with ANSI Z97.1 and 16 CFR 1201; test requirements for Class A/Category II.
   2. Products:
      a. 3M; Bidirectional Woven Copolymer Tape 960G; www.3m.com.
      b. C.R. Laurence Co., Inc.; 2MT Series: www.crlaurence.com.
      c. ShurTape Technologies, LLC; SS501 Shatterstop Safety Mirror Backing Tape: www.shurtape.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Mirror Adhesive: High strength adhesive that remains flexible and is compatible with safety backing; low VOC.
   1. Application Temperature: 60 to 100 degrees F at contact surfaces.
   2. Volatile Organic Content (VOC): Less than 250 g/L.
   3. Products:
      a. Dow Corning Corporation; DOWSIL 817 Mirror Adhesive: www.dowcorning.com.
      b. PPG Industries, Inc.; Liquid Nails Mirror Adhesive LN-730: www.liquidnails.com.
      c. Royal Adhesives & Sealants, LLC; Gunther Premier Plus Mirror Mastic: www.royaladhesives.com.
      d. Sika Corporation; Sikaflex-124 Mirror Grip: www.usa.sika.com
      e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces and wipe dry.

B. Properly prepare substrates for mirror adhesives according to adhesive manufacturer's instructions.

3.03 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Ensure that safety backing is applied over the entire surface of all mirror back sides.

E. Mirror Clips:
   1. Install according to clip manufacturer's instructions.
   2. Install bottom clips to substrate at location of mirror bottom.
      a. Space clips as recommended by clip manufacturer but not more than 36 inches on center; minimum of 2 clips.
   3. Install clip receivers to substrate at location of mirror top.

a. Space clips as recommended by clip manufacturer but not more than 36 inches on center; minimum of 2 clips.

4. Apply mirror adhesive to substrates; keep 4 inches away from mirror edges.
   a. Apply in vertical beads or patties.
5. Position mirror in bottom clips and press firmly into adhesive.
   a. Adhesive shall be compressed to 1/16 inch thickness, maximum.
6. Install top clips into receivers.
7. Ensure that mirror is properly aligned and secured by clips without excessive movement or vibrations.

3.04 CLEANING

A. Remove labels after work is complete.

B. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 09 0561 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing of concrete floor slabs for moisture and alkalinity (pH).
B. Remedial floor coatings for concrete floor slabs.

1.02 PRICE AND PAYMENT PROCEDURES

A. Remedial Floor Coatings.
   1. Contractor shall perform all required remediation of concrete floor slabs;
      a. Contractor shall perform the work at no additional cost to Owner where moisture vapor reduction admixture (MVRA) was required as part of the concrete mix design.
      b. Where remedial floor coating was indicated, Contractor shall perform the work at no additional cost to Owner
      c. At floor slabs where remedial floor coatings were not indicated, a contract modification will be issued based upon the following:
         1) Unit pricing as specified in Section 01 2200 - Unit Prices.
         2) No unit pricing or allowances were provided; Contractor shall record and submit written records of costs, including material quantities used, number of labor hours used, and total area, in square feet, of remediated concrete.

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2022.
C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
D. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

A. Testing Reports:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Submit reports to Architect.
   6. Submit reports not more than two business days after conclusion of testing.
B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's statement of compatibility with types of flooring, including adhesives, applied over remedial product.
   2. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.06 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
   1. At Contractor's option, tests may be performed by the Contractor.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
C. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and at least 5 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
B. Deliver materials in manufacturer's packaging; include installation instructions.
C. Keep materials from freezing.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Remedial Floor Coating: Single- or multi-layer coating intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
   2. Provide resistance to up to 95 percent relative humidity and 15 pounds moisture vapor transmission.
   3. Provide resistant to alkalinity (pH) level of pH 14.
   4. Products:
      a. Maxxon Corporation; Aquafin Vaportight Coat-SG4: www.maxxon.com.
      b. Schonox, HPS North America, Inc.; MR-18: www.hpsubfloors.com.
      c. Specialty Products Group; Vapor Lock 0/0: www.spggogreen.com.
      d. Spray-Lock; SCP 578: www.concreteprotection.com.
      e. Tnemec Company, Inc; Epoxoprime MVT Series 208 : www.tnemec.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
B. Do not use solvents or other chemicals for cleaning.

3.02 MOISTURE VAPOR EMISSION TESTING

A. Moisture vapor emission testing for concrete floor slabs.
   1. Test where adhesive applied floor finishes are to be installed, and where indicated.
B. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
C. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
D. Test in accordance with ASTM F1869 and as follows.

E. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
F. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
   1. After remedial floor coating has been applied, perform the test again.
      a. If test values exceed floor covering manufacturer's limits, notify Architect immediately and await further instructions. Do not install finish flooring until authorized.
G. Report: Report the information required by the test method.

3.03 INTERNAL RELATIVE HUMIDITY TESTING

A. Internal relative humidity testing for concrete floor slabs.
   1. Test where adhesive applied floor finishes are to be installed, and where indicated.
B. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
C. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
D. Test in accordance with ASTM F2170 Procedure A and as follows.
E. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
F. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
   1. After remedial floor coating has been applied, perform the test again.
      a. If test values exceed floor covering manufacturer's limits, notify Architect immediately and await further instructions. Do not install finish flooring.
G. Report: Report the information required by the test method.

3.04 ALKALINITY TESTING

A. Alkalinity testing for concrete floor slabs.
   1. Test where adhesive applied floor finishes are to be installed, and where indicated.
B. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
C. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
D. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.
   1. After remedial floor coating has been applied, perform the test again.
      a. If test values exceed floor covering manufacturer's limits, notify Architect immediately and await further instructions. Do not install finish flooring until authorized.
E. Report: Report test results.

3.05 APPLICATION OF REMEDIAL FLOOR COATING

A. Apply remedial floor coating to concrete floor slabs as indicated on Drawings.

B. Apply remedial floor coating to concrete slabs that fail one or more of the following tests:

1. Moisture vapor emission testing .
2. Internal relative humidity testing.
3. Alkalinity testing.

C. Install in accordance with remedial floor coating manufacturer's instructions and as follows:

1. Shot blast or mechanically abrade concrete surfaces to meet surface profile of 3 to 4 per ICRI 310.2R; acid etching is not permitted.
2. Vacuum and clean slab to remove all dust, dirt, and debris.
3. Apply one to two coats of remedial floor coating as recommended by remedial floor coating manufacturer.

3.06 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal non-load-bearing interior partition, ceiling, and soffit framing.
B. Shaft wall framing.
C. Suspension systems for interior ceilings and soffits.
D. Framing accessories.

1.02 REFERENCE STANDARDS

A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
G. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018, with Editorial Revision.
H. ASTM D3575 - Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.
I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
K. ASTM E413 - Classification for Rating Sound Insulation; 2022.
L. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
M. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2017.
N. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2009 (Reapproved 2020).
O. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.
P. GA-600 - Fire Resistance Design Manual; 2015.
Q. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
R. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
S. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings:
   1. Indicate component details, control joints, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, and accessories.
   2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
   3. Coordinate with Section 09 2900
C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
E. Manufacturer's Qualification Statement.
F. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Shaft Wall Framing, Connectors, and Accessories:
1. ClarkDietrich Building Systems: www.clarkdietrich.com.
2. Jaimes Industries Inc.: www.jaimesind.com.
3. MarinoWARE: www.marinoware.com.
4. MBA Building Supplies, Inc.: www.mbastuds.com.
5. State Building Products; www.statebp.com.
6. The Steel Network, Inc: www.SteelNetwork.com.
7. Telling Industries; www.buildstrong.com.
8. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Fire-Rated Assemblies: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 and as follows:
1. Provide construction equivalent to one of the following:
a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
b. Gypsum Association File Numbers: Provide construction complying with requirements of GA-600 for the particular assembly.
C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
D. Shaft Walls: Provide completed assemblies with the following characteristics:
1. Comply with requirements of Fire-Rated Assemblies.
2. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
a. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.
E. Horizontal Deflection: For wall assemblies, limit maximum deflection of wall framing to L/240 at 5 psf .
1. Exception: Limit deflection of walls to receive hard tile surfaces to L/360 at 5 psf.
F. Protective Coatings: Equivalent (EQ) coatings are not acceptable; products shall be hot-dip galvanized as indicated.
G. Embossed (equivalent thickness) steel framing products are not acceptable; products shall be in steel thicknesses indicated.

2.03 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated.
   1. Protective Coating: ASTM A653/A653M, G60, hot-dip galvanized.
   2. Minimum Metal Thickness: 0.030 inch (20 gage).
   3. Framing Depths: As indicated.
   4. Profiles:
      a. Studs: C shaped with flat or formed webs.
      b. Runners: U shaped, sized to match studs.
         1) Where indicated or required, provide slip-type head joints using slotted deflection track.
      c. Ceiling Channels: C shaped.
      d. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Slotted Deflection Track: Provide galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings. Slotted connections prevent stud rotation without use of lateral bracing and maintains structural performance of partition.
   1. Provide at partition heads to structure connections.
   2. Shall prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above
   3. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   4. Comply with ASTM C645 and ASTM C754.
   5. Protective Coating: ASTM A653/A653M, G60, hot-dip galvanized.
   6. Minimum Metal Thickness: Same material thickness as studs.
   7. Track Depth: Matching studs.
   8. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
      a. At Contractor's option, provide the following:
         1) Slotted Deflection and Firestop Track: Similar to standard slotted deflection track specified, but includes intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.
            (a) Products:
               (1) ClarkDietrich Building Systems; BlazeFrame Firestop Deflection Track : www.clarkdietrich.com.
               (2) MarinoWARE; FAS Track 1000: www.marinoware.com.
               (3) Substitutions: See Section 01 6000 - Product Requirements.

C. Preformed Top Track Firestop Seal: Pre-formed firestop device field-applied to head of top track that expands when exposed to heat or flames to provide a perimeter joint seal.
   1. At Contractor's option provide preformed top track firestop seals instead of traditional perimeter joint seals.
   2. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
   3. Products:
      a. Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Resilient Furring Channels: Galvanized sheet steel, single leg, asymmetrical channel, 1/2 inch deep with a 1-1/4 inch screw flange; complying with ASTM C645.
   1. Exception: At ceilings provide double leg, symmetrical channels.
   2. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
   3. Minimum Metal Thickness: 0.0179 inch (25 gage).

E. Z-shaped Furring: Galvanized sheet steel z-shaped furring, 2 inches deep, unless otherwise indicated; complying with ASTM C645.
   1. Protective Coating: ASTM A653/A653M, G60, hot-dip galvanized.
   2. Minimum Metal Thickness: 0.0312 inch (20 gage).

2.04 FRAMING ACCESSORIES

A. Bridging and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
   1. Steel, 0.0538-inch (1.37mm) minimum base-metal thickness, with a minimum 1/2-inch (13mm) wide flanges.
      a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Systems Spazzer 9200 Bridge and Spacing Bar, or equivalent.

B. Backing Plates: 0.064 inch thick (16 gage), galvanized.

C. Wood Blocking: Refer to Section 06 1000 - Rough Carpentry.

D. Anchorage Devices: Powder actuated or Drilled expansion bolts.

E. Acoustic Sealant: As specified in Section 09 2900 - Gypsum Board.

F. Isolation Strip: Foam gasket, ASTM D3575, closed-cell vinyl foam strips, 1/8 inch thick, in width to suit steel stud size.
   1. Manufacturer:
      a. Williams; Everlastic EVA 200; www.williamsproducts.net.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 SHAFT WALL FRAMING MATERIALS

A. Non-Load-Bearing Steel Framing: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated and complying with requirements for fire-resistance-rated assembly indicated.
   1. Protective Coating: ASTM A653/A653M, G90, hot-dip galvanized.
   2. Minimum Metal Thickness: 0.0329 inch (20 gage).
   3. Profiles:
      a. Studs: Manufacturer's standard C-H or C-T profile.
         1) Depth: As indicated.
      b. Runners: Manufacturer's standard J-profile track; matching studs in depth.
      c. Slotted Deflection Track: As specified in "Framing Materials" above.
   4. Fasteners and Associated Materials: As specified in "Framing Accessories" above.

2.06 SUSPENSION SYSTEMS

A. Carrying Channels: ASTM C955; cold-rolled galvanized steel sheet U-channel.
   1. Protective Coating: ASTM A653/A653M, G60, hot-dip galvanized.
   2. Minimum Metal Thickness: 0.064 inch (16 gage).
   3. Depth: 2 inches unless otherwise indicated.

B. Furring Channels:
   1. Hat-Shaped, Rigid Furring Channels: As specified in "Framing Materials" above.
   2. Resilient Furring Channels: As specified in "Framing Materials" above.

C. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch (16 gage) diameter or double strand of 0.048-inch (18 gage) diameter wire.

D. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (8 gage) diameter.

E. Hanger Attachments to Concrete:
   1. Expansion Anchors: Fastener systems with evaluations based on ICC-ES AC193.
   2. Adhesive Anchors: Fastener systems with evaluations based on ICC-ES AC308.
   3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   4. Material for Exterior Locations and Interior Wet/Humid Locations: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. At Contractor's option provide grid suspension system instead of traditional carrying and furring channels.
   2. Not permitted for multi-layer gypsum board systems.
   3. Manufacturers:
      a. Armstrong World Industries, Inc.; Drywall Grid Suspension System: www.armstrongceilings.com.
      b. CertainTeed/Saint-Gobain; Quickspan Locking Drywall Grid System: www.certainteed.com.
      c. USG Corporation: Drywall Suspension System: www.usg.com
      d. Substitutions: See Section 01 6000 - Product Requirements

2.07 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.
B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

3.02 INSTALLATION OF STUD FRAMING

A. Comply with requirements of ASTM C754.
B. Install framing, shaft wall framing, suspension systems, and related accessories and components in accordance with manufacturer's instructions.
C. Extend partition framing to structure where indicated and to 4 inches above ceiling in other locations unless otherwise indicated.
D. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling framing in accordance with details.
E. 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 as indicated.
F. Align and secure top and bottom runners at 24 inches on center.
G. Fire-Resistance-Rated Partitions: Install framing, including shaft wall framing, to comply with fire-resistance-rated assembly indicated.
H. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
   1. At partitions indicated with an acoustic rating:
      a. Provide components and install as required to produce STC ratings indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
      b. Place two beads of acoustic sealant between runners and substrate, studs and adjacent construction.
I. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
J. Install studs vertically at 16 inches on center, unless otherwise indicated.
   1. Install studs so flanges within framing system point in same direction
K. Align stud web openings horizontally.
L. Secure studs to tracks using fastener method. Do not weld.
M. Stud splicing is not permissible.
N. Fabricate corners using a minimum of three studs.
O. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
P. Brace stud framing system rigid.

Q. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
R. Blocking/Backing: Use metal backing plate, wood blocking, or supplementary framing secured to studs. Provide blocking/backing for support of equipment services, plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and similar construction.
S. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.
T. Do not bridge building control and expansion joints. Frame both sides of joints independently.
   1. Install Horzontal stiffeners in stud system, spaced (vertical distance) not more than 4'-6" o.c.
U. General requirements and locations of control joints in metal-framed gypsum board construction:
   1. General: Comply with requirements of ASTM C840, and as noted below:
      a. Control joints shall be constructed with manufactured control joint trim, or field fabricated from materials as specified.
      b. Control joints will be installed where a partition, wall, or ceiling traverses and construction joint (expansion, or building control element) in the base building structure.
      c. Control joints will be installed where a wall or partition extends in an uninterrupted straight plane exceeding 30 linear feet. Door and/or window frames that extend full height of partitions will be considered equivalent to control joint construction.
      d. Control joints in interior ceilings, bulkheads, fasciae and soffits will be installed so that linear dimensions between control joints do not exceed 30 linear feet and total area between control joints does not exceed 900 square feet. Control joints will be installed to isolate wings of “L”, “U: and “T” shaped ceiling and soffit areas.
      e. A control joint will be installed where ceiling, bulkhead, fascia and soffit framing members change direction.
      f. Provide appropriate backing material, fire-safing insulation, and sealant for control joints installed in acoustical or fire-rated construction, as required to maintain fire-rating and/or acoustical separation.
V. Where studs are installed directly against exterior masonry walls, install isolation strip between studs and exterior wall.

3.03 CEILING AND SOFFIT FRAMING

A. Comply with requirements of ASTM C754.
B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
C. Install furring independent of walls, columns, and above-ceiling work.
D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated.
   1. Space hangers at maximum 48 inches on center.
   2. Do not attach hangers to the following:
      a. Metal deck or rolled-in hanger tabs of composite metal deck.
      b. Permanent metal forms.
      c. Ducts, pipes, or conduit.
   3. 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.
   4. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

5. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    a. Size supplemental suspension members and hangers to support ceiling loads within performance requirements.

E. Space main carrying channels at maximum 48 inch on center, and not more than 6 inches from wall surfaces. Lap splices securely.

F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
    1. Space furring channels at maximum 24 inches on center.

H. Laterally brace suspension system.

I. Grid Suspension Systems:
    1. Attach perimeter wall angle where grid suspension systems meet vertical surfaces.
    2. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.04 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

C. Maximum variation From Level: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 2900 - GYPSUM BOARD

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum wallboard.
B. Shaft wall liner panels.
C. Tile backing board.
D. Finishing materials.
E. Trim accessories.
F. Acoustic insulation.

1.02 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
F. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
H. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
I. 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; 2018.
J. 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.
K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
L. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
M. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
N. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
O. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2019.
P. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
S. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
T. ASTM E413 - Classification for Rating Sound Insulation; 2022.
U. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

V. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.
W. GA-600 - Fire Resistance Design Manual; 2015.
X. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
   1. Include locations of control joints. Coordination drawings for proposed control joint locations may be annotated copies of Construction Documents architectural floor plans, reflected ceiling plans, and interior elevations. Submit prior to commencement of framing installation. Coordinate with requirements specified in Section 09 2216.
C. Product Data: Provide data on gypsum wallboard, shaft wall liner panels, tile backing panels, finishing materials, trim accessories, acoustical accessories, and fasteners and adhesives.
D. Samples:
   1. Submit three samples of each board type, 4 inches square in size.
   2. Submit three samples of each type of special trim, 4 inches in length.
E. Manufacturer's Qualification Statement.
F. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

A. Ambient Condition (Environmental Limitations): Comply with ASTM C840 and GA-216 requirements or gypsum board manufacturer's written instructions, whichever are more stringent

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Fire-Rated Assemblies: For fire-resistance-rated assemblies that incorporate gypsum board, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 and as follows:
   1. Provide construction equivalent to one of the following:
      a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
      b. Gypsum Association File Numbers: Provide construction complying with requirements of GA-600 for the particular assembly.
C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
D. Shaft Walls: Provide completed assemblies with the following characteristics:
   1. Comply with requirements of Fire-Rated Assemblies.
   2. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
      a. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
      b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.

E. Horizontal Deflection: For wall assemblies, limit maximum deflection of wall framing to L/240 at 5 psf .
   1. Exception: Limit deflection of walls to receive hard tile surfaces to L/360 at 5 psf.

2.02 GYPSUM WALLBOARD

A. Gypsum Wallboard: Paper-faced gypsum panels; ASTM C1396/C1396M.
   1. Thickness: 1/4 and 1/2 inch.
   2. Long Edges: Tapered with paper face wrapping edge.
   3. Short Edges: Square cut.
   4. Sized to minimize joints.
   5. Products:
      a. CertainTeed Corp.; Regular Gypsum Board: www.certainteed.com.
      b. Continental Building Products; Regular Drywall: www.continental-bp.com.
      c. Georgia-Pacific Gypsum; ToughRock Gypsum Board: www.gp.com.
      d. National Gypsum Company; Gold Bond Brand Gypsum Board: www.nationalgypsum.com.
      e. USG Corporation; Sheetrock Brand Gypsum Panels: www.usg.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard - Type X: Paper-faced gypsum panels with fire-resistant core; ASTM C1396/C1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered with paper face wrapping edge.
   3. Short Edges: Square cut.
   4. Sized to minimize joints.
   5. Type: Fire resistance rated Type X, UL or WH listed.
   6. Products:
      a. CertainTeed Corp.; Type X Gypsum Board: www.certainteed.com.
      b. Continental Building Products; Firecheck Type X: www.continental-bp.com.
      c. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gp.com.
      d. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board: www.nationalgypsum.com.
      e. USG Corporation; Sheetrock Brand Firecode X Panels: www.usg.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

C. Abuse Resistant Gypsum Wallboard: Heavy paper-faced, mold and moisture resistant, gypsum panel with fire-resistant core; ASTM C1396/C1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered with paper face wrapping edge.
   3. Short Edges: Square cut.
   4. Sized to minimize joints.
   5. Type: Fire resistance rated Type X, UL or WH listed.
   6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   7. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   8. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   9. Soft Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   10. Hard Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   11. Products:
      a. CertainTeed Corp.; Extreme Abuse Resistant Gypsum Board: www.certainteed.com.
      b. Continental Building Products; Protecta AR 100 Type X with Mold Defense: www.continental-bp.com.
      c. National Gypsum Company; Gold Bond Brand Hi-Abuse XP Gypsum Board: www.nationalgypsum.com.

d. USG Corporation; Sheetrock Brand Mold Tough AR Firecode X Panels: www.usg.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SHAFT WALL LINER PANELS

A. Gypsum Shaft Wall Liner Panels: Moisture resistant paper-faced gypsum liner panels with fire-resistant core; ASTM C1396/C1396M
1. Thickness: 1 inch.
2. Width: 24 inches.
3. Long Edges: Double beveled with paper face wrapping edge.
4. Short Edges: Square cut.
5. Sized to minimize joints.
6. Type: Fire resistance rated Type X, UL or WH listed.
7. Products:
a. CertainTeed Corp.; M2Tech Shaftliner Type X: www.certainteed.com.
b. Continental Building Products; Shaftliner Type X: www.continental-bp.com.
c. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gp.com.
d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner: www.nationalgypsum.com.
e. USG Corporation; Sheetrock Brand Gypsum Liner Panels: www.usg.com.
f. Substitutions: See Section 01 6000 - Product Requirements.

2.04 TILE BACKING BOARDS

A. Cementitious Backer Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
1. Thickness: 5/8 inch.
2. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Locations: Wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:
a. Showers.
b. Swimming pool areas.
5. Products:
a. National Gypsum Company; PermaBase Brand Cement Board: www.nationalgypsum.com.
b. USG Corporation; Durock Brand Cement Board: www.usg.com.
c. Substitutions: See Section 01 6000 - Product Requirements.

B. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
1. Thickness: 5/8 inch.
2. Type: Fire resistance rated Type X, UL or WH listed.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Locations: Non-wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:
a. Kitchens.
b. Laundry areas.
c. Locker rooms.
d. Toilet rooms.
5. Products:
a. CertainTeed Corp.; GlasRoc Diamondback Tile Backer: www.certainteed.com.
b. Georgia-Pacific Gypsum; DensShield Tile Backer: www.gp.com.
c. National Gypsum Company; Gold Bond Brand eXP Tile Backer: www.nationalgypsum.com.
d. USG Corporation; Durock Brand Glass-Mat Tile Backerboard: www.usg.com.

e. Substitutions: See Section 01 6000 - Product Requirements.

2.05 FINISHING MATERIALS

A. Joint Materials: ASTM C475/C475Mand as recommended by gypsum board manufacturer for project conditions.
1. Paper Tape: 2 inch wide, creased paper tape for joints and corners.
a. Exception: At tile backing board provide the following:
1) Fiberglass Tape: 2 inch, coated glass fiber tape for joints and corners.
b. Manufacturers: Provide products from one of the specified gypsum wallboard manufacturers.
2. Joint Compound: Drying and setting types, vinyl-based, ready-mixed or field-mixed.
a. Each coat shall be compatible with previously applied coats.
b. Manufacturers: Provide products from one of the specified gypsum wallboard manufacturers.

2.06 TRIM ACCESSORIES

A. Trim Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Types: As detailed or required for finished appearance. Including, but not limited to, the following:
a. Corner beads.
b. Control joints.
c. LC or L bead at exposed edges.
2. Products:
a. ClarkDietrich Building Systems: www.clarkdietrich.com.
b. Marino\WARE: www.marinoware.com.
c. Telling Industries; www.buildstrong.com.
d. Phillips Manufacturing Co: www.phillipsmfg.com.
e. USG Corporation: www.usg.com.
f. Substitutions: See Section 01 6000 - Product Requirements.

B. Special Trims: Extruded aluminum profiles; ASTM B221 6063 T5 alloy.
1. Manufacturers:
a. Fry Reglet Corp.; www.fryreglet.com.
b. Gordon, Inc.; www.gordon-inc.com.
c. Pittcon Industries; www.pittconindustries.com.
d. Substitutions: See Section 01 6000 - Product Requirements.
2. Shapes and Profiles: As indicated on Drawings, including, but not limited to, the following:
a. Reveals: Equal to Fry Reglet Model DRM-625-625.
1) Reveal Size: 5/8 inch wide by 5/8 inch deep
b. F-Reveals: Equal to Fry Reglet Model DRMF-625-625.
1) Reveal Size: 5/8 inch wide by 5/8 inch deep
c. Wall End Caps: Equal to Fry Reglet DMEC Series.
1) Size to match wall construction.
d. Finish: Manufacturer's standard conversion coating or primed finish.

C. Partition Closures: Provide one of the following types.
1. Aluminum Partition Closure: Aluminum spring loaded partition closure assembly with acoustical insulation.
a. Extruded aluminum; ASTM B221 6063 T5 alloy
b. Provide all auxiliary materials and hardware for a complete installation.
c. Minimum STC rating of 38.
d. Finish: Manufacturer's standard powder coating; custom color to match Architect's sample.
1) Color: To match adjacent glazing framing unless otherwise indicated.
e. Size closure to fit tightly in vertical juncture between end of partition and windows, glazing, and similar construction.
f. Products:

1) Gordon, Inc.; MullionMate Series: www.gordon-inc.com.
2) Substitutions: See Section 01 6000 - Product Requirements.

2. Foam Partition Closure: Silicone coated foam closures; compression fitted.
   a. Foam: Manufacturer's standard open-cell, fire-resistant foam core.
      1) Fire-resistance: Class A per ASTM E90.
   b. Finish Coating: Silicone; smooth finish.
      1) Provide finish on exposed sides, and sides compressed against glazing.
      2) Silicone Coating Color: Custom color to match Architect's sample.
         (a) Color: To match adjacent glazing framing unless otherwise indicated.
   c. Minimum STC rating of 53.
   d. Depth of Seal: 2 inches, minimum.
   e. Size closure to fit tightly in vertical juncture between end of partition and windows, glazing, and similar construction.
   f. Products:
      1) Emseal Joint Systems, Ltd.; QuietJoint: www.emseal.com.
      2) Substitutions: See Section 01 6000 - Product Requirements.
3. Partition Closures: .
   a. Sound Barrier Mullion Trip Cap
      1) Products: MULL-it-OVER Products Mullion Trim Cap
      2) Substitutions: See Section01 6000-Product Requirements.
   b. Profile: 55 Classic Mullion Trim Cap
   c. Aluminum Extrusion:
      1) Thickness: 1/8 inch.
   d. Sound Absorbing Foam:
      1) Resistant to smoke, flame, and microbial growth.
      2) Fire Rating: ASTM E84 Class 1.
      3) Fungi Resistance: Zero rating per ASTM G21.
   e. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.
      1) Thickness: as required to accommodate mullion deflection.
      2) Color: Light gray.
   f. Fasteners:
      1) Self Tapping or appropriate threaded fastener.
      2) Compatible with all materials fasteners will contact with and not causing galvanic corrosion.
   g. Snap Cover: Snap-on fastener cover
   h. Acoustical Sound Sealant: Acrylic latex based.
   i. Accessories: Provide necessary and related parts and tools to complete installation.
   j. Fabrication: Extrusions and generic profiles to be shipped in custom lengths as required to meet project requirements or shipped in standard incremental foot lengths and cut to exact length on jobsite.
   k. Finishes: Exposed surfaces of exposed aluminum extrusion:
   l. Aluminum: Architect to select from manufacturer's custom color offering to match adjacent storefront finish.

2.07 ACOUSTICAL ACCESSORIES

A. Acoustic Insulation: Provide one of the following types:
   1. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.
      a. Thickness: 3 inches, unless otherwise indicated.
      b. Density: 2.5 pcf.
      c. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
      d. Products:
         1) JohnsManville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com.

2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
3) Rockwool; Safe'n'Sound: www.rockwool.com.
4) Substitutions: See Section 01 6000 - Product Requirements.

2. Fiberglass Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced.
   a. Thickness: 3-1/2 inches, unless otherwise indicated.
   b. Products:
      1) CertainTeed Corporation/Saint-Gobain; NoiseReducer Sound Attenuation Batts: www.certainteed.com.
      2) Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
      3) Knauf Insulation; EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.com.
      4) Owens Corning Corporation; EcoTouch Sound Attenuation Batts: www.owenscorning.com.
      5) Substitutions: See Section 01 6000 - Product Requirements.

B. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Reduces airborne sound transmission through perimeter joints and openings in wall assemblies.
   1. Products:
      a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: www.titebond.com.
      b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: www.liquidnails.com.
      c. Pecora Corporation; AC-20 FTR: www.pecora.com.
      d. Pecora Corporation; AIS-919: www.pecora.com.
      e. United States Gypsum Co.; USG Sheetrock Brand Firecode Smoke-Sound Sealant: www.usg.com.
      f. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: www.usg.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

2.08 FASTENERS AND ADHESIVES

A. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

B. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

C. Screws for Fastening of Cementitious Backer Board Products to Steel Studs: Use screws of type and size recommended by panel manufacturer

D. Anchorage to Other Substrates: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

E. Laminating Adhesive: For directly adhering gypsum-base, face-layer panels to backing-layer panels in multi-layer construction. Provide one of the following types:
   1. Joint Compound: As recommended by gypsum board manufacturer.
   2. Adhesives:
      a. Franklin International, Inc; Titebond GREENchoice Professional Drywall Adhesive; www.titebond.com.
      b. PPG Architectural Coatings; Liquid Nails DWP-24 Drywall Construction Adhesive: www.liquidnails.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

B. Control Joint Layout: Prior to commencement of framing and gypsum board installation, submit coordination drawings indicating proposed control joint locations in metal-framed gypsum board-sheathed partitions, walls, ceilings, bulkheads, fasciae, and soffits, for review and acceptance of Architect. Coordinate with requirements of Section 09 2216.

3.02 GENERAL INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. General: Apply acoustic accessories at all STC-Rated Assemblies and elsewhere as indicated on Drawings.
   1. Apply acoustic sealant at all smoke-tight assemblies.
   2. Fire-Rated Construction: Install acoustic accessories in strict compliance with requirements of assembly listing.

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.
   1. Comply with ASTM C919.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, rough-in boxes, and similar items, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Install to minimize butt end joints, especially in highly visible locations.
   1. Use screws for attachment of gypsum board.
   2. Use screws for attachment of cementitious backing board.

B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with long edges occurring over framing.
   1. Stagger joints on opposite sides of partitions.

C. Multi-Layer Non-Rated: Install first layer of gypsum board parallel to framing with long edges occurring over framing. Place second layer parallel to framing with long edges occurring over framing, and joints offset from joints of first layer.
   1. Offset face-layer joints at least one stud or furring member from base-layer joints.
   2. Stagger joints on opposite sides of partitions.
   3. Install additional layers beyond double layers similarly; maintain offset and staggered joints between layers.
   4. Apply laminating adhesive between layers of gypsum board for bonding of layers in addition to fasteners.

D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Cementitious Backing Board: Install in accordance with ANSI A108.11 and manufacturer's instructions.

F. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Not more than 30 feet apart on walls and ceilings, unless otherwise indicated.
   2. Submit control joint locations to Architect for approval prior to installation.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim (LC or L Beads): Install at locations where gypsum board abuts dissimilar materials and as indicated, using longest practical lengths.

D. Special Trim: Install at indicated locations, and as follows.
   1. Wall End Caps: Provide at all exposed ends of wall assemblies not covered in wallboard and at locations of partition closures.

2. Use longest practical lengths.

E. Partition Closures: Locate at vertical junctures between end of wall assemblies and windows, glazing, and similar construction, unless otherwise indicated.
   1. Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.
   2. Apply continuous bead of acoustical sealant to the unexposed side of extruded aluminum surface that will be in contact with the wall edge.
   3. Place sound barrier partition closure on the vertical surface of the wall partition and loosely install fasteners in the top and bottom slotted holes of the wall end cap.
   4. Plumb the partition closure leaving recommended gap spacing between the interior glass surface and the wall end cap. Foam gasket to be in contact with glass.
   5. Tighten top and bottom fasteners to secure partition closure.
   6. Install additional fasteners at 12 inches on center, minimum.
   7. Install snap cover to conceal fasteners.
   8. Apply color matched sealant at joints of dissimilar materials.

3.06 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying or setting type joint compound and finish with drying type joint compound.

B. Tile Backing Panels: Use fiberglass joint tape, embed and finish with tile setting material.
   1. Refer to Section 09 3000 - Hard Tiling for tile setting materials.

C. Glass Mat Faced Gypsum Board other than Tile Backing Panels: Use fiberglass joint tape, embed and finish with setting type joint compound.

D. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and in similar locations that shall not be painted or finished, and at tile backing board to receive tile finish.
   3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
      a. Exception: Fire-Rated Construction shall comply with requirements of assembly listing.

E. 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.
   2. Taping, filling and sanding is not required at base layers of multi-layer applications.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 3000 - HARD TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hard tile.
B. Hard tile trim units.
C. Tile setting materials, grout, sealants, and accessories.
D. Metal trim.
E. Waterproofing, Uncoupling, and Crack Isolation Membranes.

1.02 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 A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
E. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).
H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
J. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
K. 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).
L. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
M. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
N. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
O. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2017 (Reaffirmed 2022).
P. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).

Q. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.
R. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
S. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
D. Samples:
    1. Full-size units of each type of tile and each color and finish.
    2. Full-size units of each type of trim, threshold and accessory for each color and finish.
        a. Trim and Threshold Samples: 4 inches long, minimum.
E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Tile: 2 percent of each size, color, and surface finish combination, but not less than one box of each type.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.
C. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer:
D. Preinstallation Conference: Conduct conference at the Project Site.
    1. Convene one week prior to commencing work of this section.
    2. Require attendance of installation material manufacturer, tile supplier, tile installer, and intallers of related work. Review installation procedures and coordination required with related work.
    3. Meeting agenda includes, but is not limited to:
        a. Surface preparation.
        b. Tile and installation material compatibility.
        c. Manufacturer and installer warranty duration and scope coverd by warranty.
        d. Edge protection, transition, and pre-fabricated movement joint profiles.
        e. Waterproofing techniques.
        f. Crack isolation techniques.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
B. Construct mockups to demonstrate aesthetics and quality of materials and execution.
    1. Build mock-up of each type of floor tile and installation method.
    2. Build mock-up of each type of wall tile and installation method.
    3. Build mock-up of any other specific locations as requested by the Architect.

4. Mockup sizes shall be sized as appropriate to demonstrate complete tile pattern layout; 16 square feet, minimum.
5. Approved mock-ups may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.

B. Storage: Store materials as directed by manufacturer's written instructions.

1.08 FIELD CONDITIONS

A. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Floor Tile: Floor tile shall comply with the following:
1. Dynamic Coefficient of Friction (DCOF): 0.42 or greater when tested in accordance with DCOF AcuTest per ANSI A137.1.

2.02 HARD TILE

A. CT1 Floor Tile: ANSI A137.1 standard grade.
1. Size: 24 by 24 inch, nominal.
2. Thickness: 5/16 inch, nominal.
3. Surface Finish: Unglazed.
4. Color: Confetti Flecks PK23.
5. Joint Size: 1/8 inch.
6. Base: Field Cut of CT1 with Metal Edge Cap (Schluter, Jolly) and Cove Trim (Schluter, DILEX-AHK).
   a. Field Cut Tile Base Size: 4 by 24 inch.
7. Installation: Monolithic.
8. Products:
   a. Daltile; Poke: www.daltile.com.
   b. Distributor: Daltile.
   c. Substitutions: Not permitted.
   d. Manufacturer's Representative: Taylor Sheppard, taylor.sheppard@daltile.com, (224) 374-4180.
   e. Lead Time: 6-8 weeks.

B. CT2 Wall Tile: ANSI A137.1 standard grade.
1. Size: 3 by 12 inch, nominal.
2. Thickness: 5/16 inch, nominal.
3. Surface Finish: Glazed.
4. Color: Snow Glossy, VTL SGSN.
5. Joint Size: 1/8 inch.
6. Installation: Vertical stacked bond installed at full wall height.
7. Products:
   a. VITL Commercial Surfaces; Spotlight: www.vitlsurfaces.com.
   b. Distributor: Virginia Tile.
   c. Substitutions: Not permitted.
   d. Manufacturer's Representative: Kathleen Black, (248) 467-4362, kathleen.black@virginiatile.com.

C. CT3 Wall Tile: ANSI A137.1 standard grade.
1. Size: 2 by 9 inch, nominal.
2. Surface Finish: Glossy.
3. Color: Moonstone.
4. Joint Size: 1/8 inch.
5. Installation: Horizontal stacked bond.

6. Products:
   a. VITL Commercial Surfaces; Remington: www.vitlsurfaces.com.
   b. Distributor: Virginia Tile.
   c. Substitutions: Not permitted.
   d. Manufacturer's Representative: Kathleen Black, (248) 467-4362, kathleen.black@virginiatile.com.
   e. Lead Time: 10-12 weeks.

2.03 SETTING MATERIALS

A. Latex-Portland Cement Thin-Set Mortar Bond Coat: ANSI A118.4, ANSI A118.11 andANSI A118.15 .
   1. Products:
      a. Bostik, Inc; Bostik PM: www.bostik.com.
      b. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar: www.custombuildingproducts.com.
      c. H.B. Fuller Construction Products, Inc; Sturdi Flex Thin Set Mortar: www.tecspecialty.com/#sle.
      d. LATICRETE International, Inc; 253 Gold: www.laticrete.com.
      e. MAPEI Corp.; Porcelain Tile Mortar: www.mapei.com.
      f. Schluter Systems L.P.; All Set Thinset Morter; www.schluter.com
      g. Substitutions: See Section 01 6000 - Product Requirements.

B. Large Format Tile Latex-Portland Cement Medium-Bed Mortar Bond Coat: ANSI A118.4, ANSI A118.11 and ANSI A118.15 .
   1. Products:
      a. Bostik, Inc; Big Tile & Stone: www.bostik.com.
      b. Custom Building Products; Natural Stone & Large Tile Premium Mortar: www.custombuildingproducts.com.
      c. LATICRETE International, Inc; 4-XLT: www.laticrete.com.
      d. MAPEI Corp.; Large Tile & Stone Mortar: www.mapei.com.
      e. Schluter Systems L.P.; All Set thinset mortar; www.schluter.com.
      f. TEC, H.B. Fuller Construction Products Inc; Ultimate Large Tile Mortar or Permalastic LHT: www.tecspecialty.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

2.04 GROUTS

A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
   1. Color(s):
      a. Color Design Intent at CT1: Mapei, 5027 Silver.
      b. Color Design Intent at CT2: Mapei, 5093 Warm Gray.
      c. Color Design Intent at CT3: Mapei, 5104 Timberwolf.
   2. Products:
      a. Bostik, Inc; EzPoxy EzClean: www.bostik.com.
      b. Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout : www.custombuildingproducts.com.
      c. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Grout and Mortar : www.tecspecialty.com/#sle.
      d. LATICRETE International, Inc; SPECTRALOCK Pro Premium: www.laticrete.com.
      e. MAPEI Corp.; Kerapoxy or Kerapoxy CQ: www.mapei.com
      f. Substitutions: See Section 01 6000 - Product Requirements.
         1) Substitutions will only be accepted for manufacturers for epoxy grout. Product substitutions for other than epoxy grouts will not be accepted.

2.05 METAL TRIM

A. Metal Trim: Provide metal profiles in heights to match tile and setting-bed thicknesses, designed specifically for hard tile applications.
   1. Profiles:

a. Angle or L-shaped.
b. Other shapes as indicated on Drawings.
2. Material: Brushed stainless steel.
3. Applications and Locations:
a. Open edges of wall tile.
b. Open edges of floor tile.
c. Outside wall corners.
d. Transitions between hard tile and other floor finishes.
e. Tile perimeters not against a wall or other solid vertical surface.
f. Other areas as indicated on Drawings.
4. Manufacturers:
a. Schluter-Systems: www.schluter.com.
b. Substitutions: See Section 01 6000 - Product Requirements.

2.06 WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. Waterproofing and Crack Isolation Membrane: Elastomeric liquid applied membrane complying with ANSI A118.10 and ANSI A118.12.
1. Applications: Use at the following locations:
a. All floor and traffic areas.
b. Other areas as indicated.
2. Thickness: As recommended by membrane manufacturer.
3. Crack Resistance: No failure at 1/8 inch gap, minimum.
4. Membrane system may or may not include fabric reinforcing.
5. Products:
a. Without Fabric Reinforcing:
1) Custom Building Products; RedGard: www.custombuildingproducts.com.
2) LATICRETE International, Inc; Hydro Ban: www.laticrete.com.
3) MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
4) Substitutions: See Section 01 6000 - Product Requirements.
b. With Fabric Reinforcing:
1) Bostik, Inc; GoldPlus: www.bostik.com.
2) Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane: www.custombuildingproducts.com.
3) LATICRETE International, Inc; Hydro Barrier: www.laticrete.com.
4) MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
5) TEC, H.B. Fuller Construction Products Inc; HydraFlex: www.tecspecialty.com.
6) Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
1. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
2. Verify that substrates comply with tolerances of TCNA (HB).
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.
1. Verify that substrates comply with tolerances of TCNA (HB).

3.02 PREPARATION

A. Protect surrounding work from damage.
B. Vacuum clean surfaces and damp clean.

3.03 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.

B. Install waterproofing and crack isolation membrane according to manufacturer's instructions and TCNA (HB) recommendations.
   1. Applications: Use at the following locations:
      a. All floor and traffic areas.
      b. Other areas as indicated.

C. Bond Coats:
   1. Use latex-portland cement thin-set mortar, unless otherwise indicated.
      a. Exceptions:
         1) For tiles that have at least one side greater than 15 inches long, use large format tile latex-portland cement medium-bed mortar.
      b. Bond Coat Color: White or gray.
         1) Exception: White at glass tiles.

D. Grout:
   1. Use epoxy grout.

E. Install tile prior to installation of equipment, cabinets, and other recessed and surface mounted items.

F. Completely cover substrates with tile, including those which will be under and behind surface mounted items in finished construction.

G. Lay tile from center lines outward unless otherwise indicated.

H. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

I. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly.

J. 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.

K. Form internal angles square and external angles square, with metal trim, or bullnose trim pieces as indicated.

L. Install accessories rigidly in place in accordance with manufacturer's instructions..

M. Install metal trim in accordance with manufacturer's instructions.

N. Install thresholds where indicated.

O. Sound tile after setting. Replace hollow sounding units.

P. Keep control and expansion joints free of mortar, grout, and adhesive.

Q. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

R. Grout tile joints unless otherwise indicated.

S. Joint Sealant:
   1. Use joint sealant at the following locations instead of grout.
      a. Tile changes in plane.
      b. Tile-to-tile control joints .
      c. Junctions of tile and dissimilar materials
      d. And elsewhere as required by TCNA (HB), EJ171 movement joint guidelines.
   2. Install joint sealant with bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

T. Grout Sealers:
   1. Seal the following:
      a. High performance grout joints only as recommended by grout manufacturer.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over concrete substrates, install in accordance with TCNA (HB) Method F122 or F122A, as appropriate to substrate conditions.
   1. Provide waterproofing and crack isolation membrane.

3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244C .
   1. Provide waterproofing and crack isolation membrane in wet areas and elsewhere as indicated.

B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
   1. Provide waterproofing and crack isolation membrane where indicated.

C. Over concrete and masonry install in accordance with TCNA (HB) Method W202I.
   1. Provide waterproofing and crack isolation membrane in wet areas and elsewhere as indicated.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended acoustical ceilings including:
   1. Metal grid suspension systems.
   2. Acoustical panels.
   3. Acoustical insulation above ceiling.

1.02 REFERENCE STANDARDS

A. ASTM B164 - Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire; 2014.
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 C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
E. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
F. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
H. 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.
I. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
J. CISCA (CSH) - Ceiling Systems Handbook.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
C. Product Data: Provide data on suspension system components and acoustical panels.suspension system components and acoustical panels.
D. Samples:
   1. Acoustical Panels: Submit 3 samples, 6 by 6 inch in size, for each type and finish of acoustical panel.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Panels: Quantity equal to 2 percent of total installed, but not less than one box for each type and finish.

1.05 QUALITY ASSURANCE

A. Metal Grid Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
B. Acoustical Panel Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

C. Installer Qualifications: Company experienced in performing acoustical ceiling installations, with minimum of 5 years of documented experience.

1.06 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Warranties: Provide the following manufacturer warranties:

1. Acoustic Panel Warranty: Against defects in materials and workmanship.
   a. Warranty Length:
      1) 30 years.
2. Metal Grid Suspension Systems: Against defects in materials and workmanship.
   a. Warranty Length:
      1) 30 years.
3. Sag Warranty: Acoustic panels shall not show visible sag.
   a. Warranty Length: 30 years.
4. Mold and Mildew Warranty: Acoustic panels shall be free from mold and mildew growth.
   a. Warranty Length: 30 years.
5. Rust Warranty: Metal grid suspension systems shall be free from the occurrence of 50 percent red rust per ASTM D610.
   a. Warranty Length: 30 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Panels: Provide either the specified product or a comparable product by one of the following:

1. Armstrong World Industries, Inc: www.armstrongceilings.com.
2. CertainTeed Corporation: www.certainteed.com.
3. USG Corporation: www.usg.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Suspension Systems and Fascia Trim: Provide either the specified product or a comparable product by one of the following:

1. Armstrong World Industries, Inc: www.armstrong.com.
2. CertainTeed Corporation: www.certainteed.com.
3. USG Corporation: www.usg.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

C. Source Limitations: Obtain acoustic panels, suspension systems, and fascia trims from one manufacturer unless otherwise indicated or approved in writing by Architect.

2.02 ACOUSTICAL PANELS

A. Acoustical Panels - General: ASTM E1264, Class A.

B. ACT-1 Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:

1. Size: 24 by 24 inches.
2. Thickness: 3/4 inch.
3. Composition: Wet felted.
4. Light Reflectance: 0.82, determined in accordance with ASTM E1264.
5. NRC: 0.70, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Edge: Square.
8. Surface Color: White.
9. Suspension System: Exposed grid Type SG-1.
10. Products:

a. Armstrong World Industries, Inc; School Zone Fine Fissured No. 1713 : www.armstrongceilings.com.

C. ACT-2 Acoustical Panels: Soil-Resistant Polyester Film faced mineral fiber, ASTM E1264 Type IV, with the following characteristics:
1. Size: 24 by 24 inches.
2. Thickness: 3/4 inch.
3. Composition: Wet felted.
4. Light Reflectance: 0.79 percent, determined in accordance with ASTM E1264.
5. NRC Range: 0.55, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Edge: Square.
8. Surface Color: White.
9. Suspension System: Exposed grid Type SG-1.
10. Products:
a. Armstrong World Industries, Inc; Clean Room FL, No. 1715 : www.armstrongceilings.com.

2.03 SUSPENSION SYSTEMS

A. Metal Grid Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, and perimeter moldings as required.

B. SG-1 Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.
1. Profile: Tee; 15/16 inch wide face.
2. Construction: Double web.
3. Finish: White painted.
4. Products:
a. Armstrong World Industries, Inc; Prelude: www.armstrongceilings.com.
b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

A. Provide all required accessories including perimeter moldings, splice plates, clips, and associated hardware, hangers, rivets, and fasteners.

B. Hanger Wire, Anchors, and Related Support Materials:
1. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
2. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
3. Size attachment devices for five times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
4. Size hanger wire for three times hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung, but not less than 0.106-inch diameter wire; three times the design load shall be less than yield stress of wire.

C. Perimeter Moldings: Same metal and finish as grid.
1. At Wall Perimeters: Provide L-shaped molding for mounting at same elevation as face of grid.
2. Provide inside and outside prefabrcated corner mouldings.
3. At Bullnose Corners: Provide radius corner moldings to match bullnose radius of adjacent walls.
4. **Teg Tabs are not acceptable.**

D. Touch-up Paint: Type and color to match acoustical and grid units.

2.05 ACOUSTICAL ACCESSORIES

A. Acoustic Insulation: Provide one of the following types:
1. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.

a. Thickness: 3 inches, unless otherwise indicated.
b. Density: 2.5 pcf.
c. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
d. Products:
1) JohnsManville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com.
2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
3) Rockwool; Safe'n'Sound: www.rockwool.com.
4) Substitutions: See Section 01 6000 - Product Requirements.

2. Fiberglass Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced.
a. Thickness: 3-1/2 inches, unless otherwise indicated.
b. Products:
1) CertainTeed Corporation/Saint-Gobain; NoiseReducer Sound Attenuation Batts: www.certainteed.com.
2) Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
3) Knauf Insulation; EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.com.
4) Owens Corning Corporation; EcoTouch Sound Attenuation Batts: www.owenscorning.com.
5) Substitutions: See Section 01 6000 - Product Requirements.

B. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C834; for use in conjunction with perimeter moldings of suspended ceiling systems.
1. Products:
a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: www.titebond.com.
b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: www.liquidnails.com.
c. Pecora Corporation; AIS-919: www.pecora.com.
d. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: www.usg.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.
B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, CISCA (CSH), 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. Locate system on room axis according to reflected plan.
D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Install moldings in bed of acoustical sealant.
2. Install moldings and grid in the same plane.
3. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends.
4. Use longest practical lengths.

5. Corners:
   a. At Bullnose Corners: Provide prefabricated radius corner moldings to match bullnose radius of walls.
   b. At Square Corners: Provide prefabricated corner moldings.
      1) At Other Angles Corners: Overlap perimeter moldings.
6. Do not use exposed fasteners, including pop rivets.

E. Hang metal grid suspension systems independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Connect hangers directly to structure, inserts, eye screws, or other connections that are secure and appropriate for substrate. Connections shall not deteriorate or corrode.

G. Fasten hangers to structural members, cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
1. Do not attach hangers to metal forms, steel deck tabs, or metal decking.

H. Support metal grid suspension systems with hangers not more than 48 inches o.c. along main grid members.
1. Support grid members directly from hangers unless otherwise indicated.
2. Provide hangers not more than 8 inches from ends of each member.

I. Install hangers plumb except where required to miss obstructions; brace splayed hangers as required to offset horizontal forces.

J. Install supplemental hanger supports to bridge large ducts and other wide obstacles that interfere with required hanger spacings or when steel framing is not located appropriately for required hanger spacings.

K. Size hangers and supplemental supports to support ceiling loads within performance limits established by referenced standards and this specification section.

L. Secure wire hangers to metal grid suspension systems and above supports with four tight turns, minimum.

M. Hangers shall not contact adjacent materials within the ceiling plenum.

N. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

O. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

P. Do not eccentrically load system or induce rotation of runners.

Q. Do not install dented, bent, or kinked metal grid suspension members.

3.04 INSTALLATION - ACOUSTICAL PANELS

A. Install acoustical panels in accordance with manufacturer's instructions and as supplemented in this section.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical panels level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
1. Make field cut edges of same profile as factory edges.
2. Field paint exposed cut edges.
3. No shadow trims to be used.

G. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions, unless otherwise indicated.

H. Lay acoustical insulation continuously across top of acoustical panel ceiling system without gaps where indicated.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

1.02 REFERENCE STANDARDS

A. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2021a.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Shop Drawings: Indicate seaming plans and floor patterns.
D. Verification Samples:
   1. Resilient Tile Flooring: Submit 3 samples, full size, for each color and pattern specified.
E. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Flooring Materials: Quantity equal to 2 percent of total installed, but not less than one box for each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum 5 years documented experience.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. RFT1Rubber Floor Tile: Homogeneous, color and pattern throughout thickness.
   1. Products:
      a. Nora; Norament Arago: www.nora.com.
      b. Substitutions: Not permitted.
      c. Manufacturer's Representative: Sofia Davila, sofia.davila@interface.com, (347) 633-0577.
   2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
   3. Size: 39.53 by 19.76 inch nominal.
   4. Total Thickness: 0.125 inch (3.5mm).
   5. Installation Pattern: Directional.

6. Color: 5177 Balance.

2.02 ACCESSORIES

A. Subfloor Filler: Cement based rapid drying smoothing and finishing compound; type recommended by adhesive manufacturer. Moisture resistant, Low VOC.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Floor Moldings and Resilient Base: Refer to Section 09 6513 - Resilient Bases and Accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Prohibit traffic until filler is fully cured.

C. Clean substrate.

D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:

1. Fully adhere resilient floor finishes to substrates using a full spread of adhesive completely covering substrate.
2. Spread only enough adhesive to permit installation of materials before initial set.
3. Fit joints and butt seams tightly.
4. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

F. Install flooring in recessed floor access covers, maintaining floor pattern.

G. At movable partitions, install flooring under partitions without interrupting floor pattern.

H. Coordinate with Section 09 6513 - Resilient Bases and Accessories for installation of floor moldings and resilient base.

3.04 INSTALLATION - TILE FLOORING

A. Mix tile from containers to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Installed floor tile shall be without open cracks, bubbling, telegraphing of adhesive spreader marks, and other imperfections.

C. Install resilient tile in floor patterns indicated.

D. Where no patterns are indicated, lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

3.05 CLEANING

A. Remove excess adhesive from floor surfaces without damage.

B. Clean, seal, and wax in accordance with manufacturer's written instructions.

1. Seal resilient floor finishes only when recommended by resilient floor finish manufacturer.
2. Wax resilient floor finishes only when recommended by resilient floor finish manufacturer.
   a. Apply not less than two coats as recommended by manufacturer.
3. Do not seal or wax luxury vinyl tile.

C. Clean resilient flooring not more than 5 days prior to Substantial Completion in accordance with resilient flooring manufacturer's instructions

3.06 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. After cleaning, place protective coverings over finish floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION

SECTION 09 6513 - RESILIENT BASES AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.
B. Floor moldings.

1.02 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Shop Drawings: Indicate seaming plans and floor patterns.
D. Verification Samples:
   1. Resilient Base and Floor Moldings: Submit 3 samples, 12 inches long illustrating color, pattern, and profile for each accessory specified.
E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Base: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.
   3. Extra Floor Moldings: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified resilient accessories with minimum 5 years documented experience.
B. Installer Qualifications: Company specializing in installing specified resilient accessories with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. RB1Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Manufacturers: Provide products from one of the following:
      a. Armstrong Flooring Inc.: www.armstrongflooring.com.
      b. Burke Flooring: www.burkeflooring.com.
      c. Johnsonite, a Tarkett Company: www.johnsonite.com.
      d. Roppe Corp: www.roppe.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

2. Height: 4 inch.
3. Thickness: 0.125 inch.
4. Finish: Satin.
5. Length: Roll.
6. Color: 40 Black.

2.02 FLOOR MOLDINGS

A. Floor Moldings: Resilient edge and transition strips for changes in flooring materials.
   1. Manufacturers:
      a. Armstrong Flooring Inc.: www.armstrongflooring.com.
      b. Burke Flooring: www.burkeflooring.com.
      c. Johnsonite, a Tarkett Company: www.johnsonite.com.
      d. Roppe Corp: www.roppe.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.
   2. Material: Rubber or vinyl as is standard with manufacturer.
   3. Profiles: As standard with manufacturer and as appropriate for floor finishes, unless otherwise indicated.
   4. Provide floor moldings at the following locations unless otherwise indicated:
      a. Open perimeters of resilient flooring; reducer strips.
      b. Open perimeters of carpeting; edge guards.
      c. Changes in floor finishes from resilient flooring to carpeting; transition strips.
      d. Other areas as indicated or required for complete floor finish installations.
   5. Colors: As selected by Architect.

2.03 ACCESSORIES

A. Primers and Adhesives: Waterproof; types recommended by accessories manufacturer.
B. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of floor moldings 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.

3.02 PREPARATION

A. Clean substrates.

3.03 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's written instructions.
B. Adhesive-Applied Installation:
   1. Fully adhere resilient base and floor moldings, to substrates using a full spread of adhesive completely covering substrate.
   2. Spread only enough adhesive to permit installation of materials before initial set.
   3. Fit joints and butt seams tightly.
C. Install floor moldings at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Install with minimal amount of joints; tops of adjacent pieces shall be aligned.
C. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
D. Install base on solid backing. Bond tightly to wall and floor surfaces.

E. At masonry and other irregular substrates fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
F. Scribe and fit to door frames and other interruptions.

3.05 INSTALLATION - FLOOR MOLDINGS

A. Install floor moldings in one piece for full width of installation, where possible.
B. Where joints are unavoidable, fit tightly together and align adjacent molding profiles.
C. Adhere over entire surface. Fit accurately and securely.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

END OF SECTION

SECTION 09 6813 - TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
C. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
D. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - 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. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings .
D. Verification Samples:
   1. Carpet Tile: Submit 3 samples, full size, for each color and pattern specified.
E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 2 percent of total installed, but not less than one box for each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum 5 years documented experience.
B. Installer Qualifications: Company specializing in installing carpet tile with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.06 EXTRA MATERIALS

A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
   1. Carpet Tile Flooring: Furnish not less than one box for each 50 boxes or fraction thereof, for each type, color, pattern, and size installed.

PART 2 PRODUCTS

2.01 MATERIALS

A. CPT1Tile Carpeting:
   1. Product:
      a. Forbo Flooring System; Coral Brush Tile: www.forbo.com.
      b. Substitutions: Not permitted.
      c. Manufacturer's Representative: Stephanie Gutowsky, stephanie.gutowsky@forbo.com, (248) 385-8805.
   2. Construction: Tufted, manufactured in one color dye lot.
   3. Tile Size: 50 x 50 cm, nominal.

4. Color: Architect to select (1) color from manufacturer's full range.
5. Installation Pattern: Vertical Ashlar.
6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
8. Fiber Content: Econyl 100%-regenerated yarn.
9. Secondary Backing Material: EVERFORT vinyl.

B. CPT2Tile Carpeting:
1. Product:
   a. Forbo Flooring Systems; Flotex Modular Frameweave Planks: www.forbo.com.
   b. Substitutions: Not permitted.
   c. Manufacturer's Representative: Stephanie Gutowsky, stephanie.gutowsky@forbo.com, (248) 385-8805.
2. Construction: Flocked high performance carpet tile.
3. Tile Size: 39.37 by 9.48 inch, nominal.
4. Colors:
   a. CPT2A: 142003 Sepia.
   b. CPT2B: 142005 Anchor.
5. Installation Pattern: Vertical Ashlar.
6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
8. Fiber Content: 100% polyamide 6.6.
9. Primary Backing Material: Recycled cushioned backing.

2.02 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.
C. Floor Moldings and Resilient Base: Refer to Section 09 6513 - Resilient Bases and Accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
D. Vacuum clean substrate.

3.03 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. Install carpet tile in floor patterns indicated.
F. Locate change of color or pattern between rooms under door centerline.
G. Trim carpet tile neatly at walls and around interruptions.
H. Coordinate with Section 09 6513 - Resilient Bases and Accessories for installation of floor moldings and resilient base.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.
C. Complete final cleaning of floor not more than 5 days prior to Substantial Completion.

3.05 PROTECTION

A. After cleaning, protect finish floors from damage until Date of Substantial Completion.

END OF SECTION

SECTION 09 7200 - WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall coverings.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on wall covering and adhesive.
C. Shop Drawings: Indicate wall elevations with seaming layout.
D. Samples: Submit 3 samples of each wall covering, 8 by 10 inch in size illustrating color, finish, and texture.
E. Test Reports: Indicate verification of flame and smoke ratings, when tested by an agency approved by authority having jurisdiction.
F. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
G. Manufacturer's Qualification Statement.
H. Installer's Qualification Statement.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.05 MOCK-UP

A. Provide panel, 8 feet wide, full height, illustrating installed wall covering and joint seaming technique.
B. Locate where directed.
C. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.
B. Protect packaged adhesive from temperature cycling and cold temperatures.
C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
B. VWC1Wall Covering- Type II: Vinyl-coated fabric wall covering.
   1. Products:
      a. Maharam; System 399600: www.maharam.com.

b. Substitutions: Not permitted.
c. Manufacturer's Representative: Somer Matty, smatty@maharam.com, (313) 686-7243.
2. Color: 001 Black.
3. Fiber Content: 100% Non-Phthalate Vinyl.
4. Weight: 20 oz/sq yd.
5. Width: 52 inches.
6. Backing: Polyester/Cellulose.

C. VWC2 Wall Covering - Type II: Vinyl-coated fabric wall covering.
1. Products:
a. Gravity Digital Walls; Framework: www.gravititydigitalwalls.com.
b. Substitutions: Not permitted.
c. Manufacturer's Representative: Andrea Angers, LBI Boyd Design Resource, andrea@lbiboyd.com, (248) 302-1355.
2. Color/Pattern: G3-09-01 Oak.
3. Weight: 20 oz/sq yd.
4. Width: 54 inches.
5. Backing: Woven, Osnaburg Fabric.
6. Repeat: As recommended by manufacturer to fit full wall extent indicated on drawings.
7. Overcoating: Manufacturer's standard Imagelock protective coating for stain resistance.

D. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
E. Substrate Primer and Sealer: Water-based type recommended by wall covering manufacturer to suit application to substrate. Allows for easy removal of wall coverings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work, and comply with requirements of wall covering manufacturer.
B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.02 PREPARATION

A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
B. Apply two coats of primer sealer to substrate surfaces in accordance with manufacturer's instructions. Allow to dry. Lightly sand smooth.
C. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
B. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
D. Butt edges tightly.
E. Horizontal seams are not acceptable, unless otherwsie indicated.
F. Do not seam within 2 inches of internal corners or within 6 inches of external corners.
G. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 09 8433 - ACOUSTIC WALL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Absorption panels:
   1. Polyester felt baffles.

1.02 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
C. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed data sheets for products specified.
C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
D. Verification Samples: Submit 3 samples of each type and finish of panel specified; 12 by 12 inch, showing construction, edge details, finish, and mounting method.
E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.
B. Installer Qualifications: Company specializing in installing acoustic wall units with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
B. Store units flat, in dry, well-ventilated space; do not stand on end.
C. Protect edges from damage.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
B. For each type of acoustical wall unit, build mockup of typical wall area include a minimum of 2 acoustical wall units. Include typical joint between acoustical wall units. Construct mock-ups of acoustical units at locations indicated by Architect.
   1. Approved mock-ups may remain as part of the Work.

PART 2 PRODUCTS

2.01 POLYESTER FELT BAFFLES

A. Drawing Designation: AB1
B. Products:MDC Interior Solutions ;Zintra Sticks - Narrow Landscape with Landscape Transition Set - Ceiling to Wall :www.zintraacoustic.com .
   1. Substitutions: Not permitted.
   2. Manufacturer's Representative: Rebecca (Knorek) Smith, (419) 450-7875, rsmith@mdcwall.com.
C. Composition: Polyethylene terephthalate (PET) plastic with a felt-like appearance.
D. Panel Thickness: 12 mm (1/2 inch).

E. Panel Depth: 4 inches.
F. Panel Width: Refer to drawings for extent.
G. Panel Edges: Square.
H. Panel Trim: Provide Zintra Sticks trim pieces on each side / edge on the wall.
I. Panel Sizes and Shapes - Width and Height: As indicated on Drawings.
J. Color: Greige.
K. Mounting Method: Manufacturer's standard aluminum tube wall brackets.
L. Performance Requirements:
   1. 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.
   2. Noise Reduction Coefficient (NRC):
      a. 12 mm (1/2 inch) panels: 0.36 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
M. Refer to Specification Section 09 8436 for acoustic ceiling unit (AB2).

2.02 FABRICATION

A. Use manufacturer's standard methods of construction; fabricate panels to sizes and configurations as indicated.
B. Provide cutouts for electrical outlets and similar items.
C. Fabric facings shall be installed without sagging, wrinkles, blisters, or visible seams.
   1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
D. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

A. Spline-Mounting Accessories: Manufacturer's standard concealed connecting splines of extruded aluminum or plastic designed for screw attachment to walls, with coordinating moldings and trim for miscellaneous conditions.
B. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
   1. Designed to support full weight of panels and provide lateral support, with one part mechanically attached to back of panel and the other attached to substrate.
C. Furring Strips: Wood furring, minimum 2 inches wide by depths indicated; straight and without significant knots or other defects.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
   1. Maintain panel joint widths/reveals as indicated
C. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
   1. Plumb and level.
   2. Flatness.
   3. Width of joints.

3.03 CLEANING

A. Clean acoustical units upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 8436 - ACOUSTIC CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Baffles:
   1. Polyester felt baffles.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed data sheets for products specified.
C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
D. Verification Samples: Submit 3 samples of each type and finish of panel specified; 12 by 12 inch, showing construction, edge details, finish, and mounting method.
E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.
B. Installer Qualifications: Company specializing in installing acoustic wall units with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
B. Store units flat, in dry, well-ventilated space; do not stand on end.
C. Protect edges from damage.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
B. For each type of acoustical ceiling unit, build mockup of typical ceiling area include a minimum of 2 acoustical ceiling units. Construct mock-ups of acoustical units at locations indicated by Architect.
   1. Approved mock-ups may remain as part of the Work.

PART 2 PRODUCTS

2.01 POLYESTER FELT BAFFLES

A. Drawing Designation: AB2
B. Location: Ceiling.
C. Products:MDC Interior Solutions ;Zintra Sticks Narrow Landscape Ceiling : www.zintraacoustic.com .
   1. Substitutions: Not permitted.
   2. Manufacturer's Representative: Rebecca (Knorek) Smith, (419) 450-7875, rsmith@mdcwall.com.
D. Composition: Polyethylene terephthalate (PET) plastic with a felt-;ike appearance.
E. Panel Thickness: 12 mm (1/2 inch).
F. Panel Edges: Square.
G. Panel Width: Refer to drawings for extent.

H. Design/Pattern: Typical Narrow Landscape Assembly (Ceiling). Refer to drawings for additional details.
I. Corner Detail in Elevation: Square, unless otherwise indicated.
J. Panel Sizes and Shapes - Width and Height: As indicated on Drawings.
K. Color: Greige
L. Mounting Method: Manufacturer's standard aluminum tube brackets with ceiling suspension frame.
    1. Include cables, clamps, and accessories for complete installation; stainless steel material.
M. Performance Requirements:
    1. 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.
N. Refer to Specification Section 09 8433 for acoustic wall unit (AB1).

2.02 FABRICATION

A. Use manufacturer's standard methods of construction; fabricate panels to sizes and configurations as indicated.
B. Fabric facings shall be installed without sagging, wrinkles, blisters, or visible seams.
    1. Where contoured surfaces or corners are indicated, install fabric to avoid seams or gathering of material.
C. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

A. Mounting Hardware - General: Manufacturer's standard hardware designed to support full weight of panels.
B. Ceiling-Suspended Accessories: Manufacturer's standard accessories at locations as indicated on each acoustical unit, sized appropriately for weight of acoustical unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
B. Suspend ceiling baffles at locations and heights as indicated
C. Set diffuser panels in metal grid suspension system at locations indicated.
D. Hang suspended panels independent of walls, columns, ducts, pipes and conduit.
    1. Connect hangers directly to structure, inserts, eye screws, or other connections that are secure and appropriate for substrate. Connections shall not deteriorate or corrode.
    2. Fasten hangers to structural members, cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
        a. Do not attach hangers to metal forms, steel deck tabs, or metal decking.
    3. Install hangers plumb except where required to miss obstructions; brace splayed hangers as required to offset horizontal forces.
    4. Install supplemental hanger supports to bridge large ducts and other wide obstacles that interfere with required hanger spacings or when steel framing is not located appropriately for required hanger spacings.
    5. Size hangers and supplemental supports to support panel loads.
    6. Hangers shall not contact adjacent materials within the ceiling plenum.
E. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:

1. Plumb and level.
2. Flatness.
3. Width of joints.

3.03 CLEANING

A. Clean acoustical units upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 9123 - INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Specification for Canyon Tone for clear block sealer is in Specification 07 1900 Water Repellent Acrylic Penetrating Sealer.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
   9. Glass.
   10. Acoustical materials, unless specifically indicated.
   11. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.03 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. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.
C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

1.05 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
B. Provide panel, 3 feet long by 3 feet wide, illustrating paint color, texture, and finish.
C. Provide door and frame assembly illustrating paint color, texture, and finish.
D. Locate where directed by Architect.
E. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
B. Provide paints and finishes from the same manufacturer to the greatest extent possible.
    1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
    2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
    3. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
    4. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.
C. Paints:
    1. Pittsburgh Paints: www.ppgpaints.com/#sle.
    2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
    3. Benjamin Moore; www.benjaminmoore.com/#sle
D. Primer Sealers: Same manufacturer as top coats.
E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
5. Supply each paint material in quantity required to complete entire project's work from a single production run.
6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. 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.
b. Architectural coatings VOC limits of the State in which the Project is located.
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.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.
5. During bidding, price accent walls as low-hide colors. Include pricing for additional prep and coats as required.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, and concrete masonry units.
1. Two top coats and one coat primer.
2. Top Coat(s): Interior Latex; MPI #44, 53, 54.
a. Products:
1) Benjamin Moore Super Hide Zero VOC Interior Latex Flat 355 (MPI #53).
2) Benjamin Moore Super Hide Zero VOC Interior Latex Low Sheen 356 (MPI #44)
3) Benjamin Moore Super Hide Zero VOC Interior Latex Semi-Gloss 358 (MPI # 53)
4) Benjamin Moore Ultra Spec 500 Interior Latex, Flat T535 (MPI #53) (Dark Colors)
5) Benjamin Moore Ultra Spec 500 Interior Latex, Low Sheen Eggshell T537 (MPI #44) (Dark Colors)
6) Benjamin Moore Ultra Spec 500 Interior Latex, Semi-Glass T546 (MPI # 54) (Dark Colors)
7) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat B30W12651 (MPI #53).

8) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
9) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eggshell. (MPI #52)

3. Top Coat Sheen:
   a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
   b. Eggshell: MPI gloss level 3; use this sheen at gypsum board, except at ceilings and wood.
   c. Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
   d. Semi-Gloss: MPI gloss level 5; use this sheen at masonry and metals .
4. Primer: As recommended by top coat manufacturer for specific substrate.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include doors and door frames.
2. Two top coats and one coat primer.
3. Top Coat(s): High Performance Architectural Interior Latex - Steel Doors and Door Frames; #141.
   a. Products:
      1) Sherwin-Williams Pro Industrial DTM Acrylic Semi-Gloss, B66W01150 Series. (MPI #141).
      2) Substitutions: See Section 01 6000 - Product Requirements
4. Top Coat(s): Interior Light Industrial Coating, Aluminum, Ferrous Metal Galvanized Steel except Steel Door and Frames Water Based; MPI #153.
   a. Products:
      1) Sherwin-Williams Pro Industrial DTM Acrylic Semi-Gloss, B66W01150 Series. (MPI #153)
5. Top Coat Sheen:
   a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

C. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
1. Shop primer by others.
2. One top coat.
3. Top Coat: Latex Dry Fall; MPI #118.
   a. Products:
      1) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
      2) Substitutions: Section 01 6000 - Product Requirements.
4. Top Coat Sheen:
   a. Flat: MPI gloss level 1; use this sheen at exposed ceiling.
5. Primer: As recommended by top coat manufacturer for specific substrate.

D. Paint I-TR-F - Fire-Retardant Coating, Intumescent:
1. One coat of fire-retardant primer sealer.

E. Paint FI-OP-3A - Fabrics/Insulation Jackets, Alkyd, 3 Coat:
1. Semi-gloss: Two coats of alkyd enamel.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Alkali Resistant Water Based Primer - Insulated Piping , Insulated Ductwork, and Previously Painted Surfaces ; MPI #3.
   a. Products:
      1) Sherwin-Williams Loxon Concrete and Masonry Primer Sealer (Existing Brick), LX02W50. (MPI #3)
      2) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-W60020 Series (MPI #3).

3) Substitutions: Section 01 6000 - Product Requirements.

2. Interior/Exterior Latex Block Filler; MPI #4.
   a. Products:
      1) Sherwin-Williams PrepRite Interior/Exterior Latex Block Filler, B25W00025. (MPI #4)
      2) Substitutions: Section 01 6000 - Product Requirements.
3. Interior Latex Primer Sealer - Gypsum Board; MPI #50.
   a. Products:
      1) Substitutions: Section 01 6000 - Product Requirements.
4. Interior Rust-Inhibitive Water Based Primer (Aluminum and Non-Gavlanized Ferrous Metals); MPI #107.
   a. Products:
      1) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #107)
      2) Substitutions: Section 01 6000 - Product Requirements.
5. Interior Water Based Primer Galvanized Metal; MPI #134.
   a. Products:
      1) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #134)
      2) Substitutions: Section 01 6000 - Product Requirements.
6. Stain Blocking Primer, Water Based; MPI #137.
   a. Products:
      1) Sherwin Williams; Multi-Purpose Latex, B51W00450 (MPI #137.
      2) Substitutions: Section 01 6000 - Product Requirements.
7. Bonding Primer, Water Based for Dryfall; MPI #17.
   a. Products:
      1) Sherwin Williams, Multi-Purpose Latex Primer/Sealer B51W00450 (MPI #17).

2.05 CONCRETE STAINS AND SEALER

A. General:
   1. Locations:
      a. Use at following locations: Unless otherwise indicated, unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs are to be finished using concrete stains.

B. Concrete Stains:
   1. Drawing Designation: CONCS.
   2. For traffic surfaces:
      a. Water-based, film forming, solid color, acrylic concrete stain; two coats.
         1) Benjamin Moore; Insl-X Tuffcrete WB Acrylic Waterproofing Concrete Stain, CST-2XXX; DFT 1.0 mils.
         2) H&C: H&C Colortop Water-Based Solid Color Concrete Stain; DFT As recommended by manufacturer.
         3) PPG; Perma-Crete Color Seal WB Interior/Exterior Concrete Stain, 4-4210XI Series, DFT 1.5 mils.
      b. Color Design Intent: Gray.

2.06 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
E. Test shop-applied primer for compatibility with subsequent cover materials.
F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
    1. Gypsum Wallboard: 12 percent.
    2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or repair existing paints or finishes that exhibit surface defects.
D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
E. Seal surfaces that might cause bleed through or staining of topcoat.
F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
G. Concrete:
H. Masonry:
    1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
    2. Prepare surface as recommended by top coat manufacturer.
I. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
J. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
K. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
L. Galvanized Surfaces:
    1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
M. Ferrous Metal - Non-galvanized:
    1. Solvent clean according to SSPC-SP 1.
    2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
        a. Re-prime entire shop-primed item.
    3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning." Protect from corrosion until coated.
N. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
O. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
P. Previously Painted Existing Surfaces:
    1. Remove all loose paint, dust, dirt, mold, mildew, oil, grease, rust, loose mill scale, mortar, and any other surface contamination.
    2. Scrape all loose, blistered, peeling, scratched or otherwise imperfect paint down to bare substrate and sand adjacent tightly adhering paint to feather edge.
        a. Tightly adhered existing paint may remain.
        b. Spot prime all bare areas with appropriate primer before re-priming entire surface.

Q. Structural Glazed Facing Tile and Hard Tile Surfaces:
   1. Remove all dust, dirt, mold, mildew, oil, grease, mortar, and any other surface contamination.
   2. Mechanically abrade surface to achieve a surface profile as reccommended by the paint manufacturer.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
D. Sand wood and metal surfaces lightly between coats to achieve required finish.
E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.
B. Owner will provide field inspection.
C. Adhesion Test to be performed per ASTM D3359 Method A (5mils or less) or B (over 5mils)
D. All coatings shall be inspected as follows:
   1. Coatings shall be rejected for the following:
      a. Lacking minimum dry film thicknesses.
         1) Inspector may test for proper dry film thickness using methods as recommended by the inspector.
      b. Poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, and corners.
      c. Damage from touching, or disturbing paint in any other manner, before sufficiently dry.
      d. Damage from application to moist surfaces or damage caused by inadequate protection from the weather.
      e. Damage or contamination of paint from blown contaminants including but not limited to dust.
   2. Coatings shall be rejected if any of the following are evident under natural lighting for exterior surfaces and final lighting source, including daylighting, for interior surfaces:
      a. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
      b. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
      c. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
E. Visible defects are defined as follows:
   1. Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
   2. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.
F. Coatings rejected by the inspection shall be repaired or replaced at the expense of the Contractor.
G. Small affected areas shall be touched up.
   1. Large affected areas shall be repainted.
   2. Small and large areas shall be as defined by the Architect.

3. Areas without sufficient dry film thickness shall be repainted.
4. Paint runs and sags shall be removed by scraper or sanding and repainted.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

3.07 SCHEDULE - PAINT SYSTEMS

A. Concrete, Concrete Masonry Units (CMU), Concrete Block, Brick Masonry: Finish surfaces exposed to view.
   1. Interior: CI-OP-3L, semi-gloss.
B. Structural Glazed Facing Tile: Finish surfaces exposed to view:
   1. Interior: I-OP-MD-WC, eggshell.
   2. Interior: I-OP-MD-WC, semi-gloss.
C. Gypsum Board: Finish surfaces exposed to view.
   1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
   2. Interior Walls: GI-OP-3A, semi-gloss.
D. Wood: Finish surfaces exposed to view.
   1. Interior trim and frames: WI-OP-3A, semi-gloss.
E. Steel Doors and Frames: Finish surfaces exposed to view; MI-OP-MD-DT, semi gloss.
F. Steel Fabrications: Finish surfaces exposed to view.
   1. Interior: MI-OP-3L, semi gloss.
G. Galvanized Steel: Finish surfaces exposed to view.
   1. Interior: Mgl-OP-3L.
H. Shop-Primed Metal Items: Finish surfaces exposed to view.
   1. Finish the following items:
      a. Elevator pit ladders.
      b. Exposed surfaces of steel stairs and railings.
I. Pipe and Duct Insulation Jackets: Finish surfaces exposed to view; FI-OP-2L, flat.

END OF SECTION

SECTION 10 1100 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass markerboards.

1.02 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 C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012.
D. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data on markerboard and accessories.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations.
    1. Include locations and layout of graphics.
    2. Include sections indicating trim profiles.
D. Samples:
    1. Markerboard Finishes: Submit 3 samples of each finish 2 by 2 inch in size illustrating finish, color, and texture.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Test Reports: Show compliance to specified surface burning characteristics requirements.
G. Maintenance Data: Include data on regular cleaning, stain removal.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package visual display boards as required to prevent damage before installation.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide Life of the building warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Visual Display Boards:
    1. ADP Lemco, Inc.; www.adplemco.com.
    2. ASI Visual Display Products, Inc., an ASI Group Company: www.asi-visualdisplayproducts.com.
    3. Claridge Products and Equipment, Inc: www.claridgeproducts.com/.
    4. Egan Visual, Inc.; www.egan.com.
    5. Ghent, a GMi company; www.ghent.com.
    6. Marsh Industries, Inc.; www.marsh-ind.com.
    7. Platinum Visual Systems; www.pvsusa.com.
    8. PolyVision Corporation: www.polyvision.com.
    9. Clarus: www.clarus.com.

10. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.03 VISUAL DISPLAY UNITS

A. MB1Magnetic Glass Markerboards:
   1. Glass: Laminated, low iron, 1/4 inch thick, with bevel edges and radiused corners, laminated to steel backing sheet for use with magnets. Coated or treated for use as dry erase board or projection surface.
   2. Glass Finish: White back-coating.
   3. Steel Backing Sheet Thickness: 24 gauge, 0.0239 inch .
   4. Size: As indicated on drawings.
   5. Frame: No frame, with concealed fasteners.
   6. Mounting: Concealed Z clips.
   7. Accessories: Provide magnetic marker tray and magnetic marker holder.

2.04 MATERIALS

A. Float Glass: Provide float-glass-based glazing unless otherwise indicated.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

C. Fiber Board: ASTM C208, cellulosic fiber board.

D. Adhesives: Type used by manufacturer.

2.05 TRIM AND ACCESSORIES

A. Frame Profile: Extruded aluminum. Manufacturer's standard J-trim.

B. Mounting Hardware: Concealed. Include brackets and all related fasteners and hardware required for a complete installation on substrates indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that internal wall blocking is ready to receive work and positioning dimensions are as instructed by the manufacturer.

3.02 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Install visual display units in locations and at heights indicated.

C. Secure units level and plumb using adhesive and mechanical fasteners.
   1. Adhesive: Adhere units to substrates with adhesive placed in patches 16 inches on center each way.
   2. Fasteners: Mechanically attach units to substrates with concealed mounting brackets not more than 16 inches on center along tops and bottoms of units.
      a. Minimum of 2 fasteners at top and bottom of each board, or panel in a combination unit.
   3. Where possible, locate wall fasteners at masonry and tile joints; do not penetrate masonry or tile faces.

3.03 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 1419 - DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dimensional letter signage.

1.02 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.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.
C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
D. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.
E. Selection Samples: Where materials, colors, and finishes are not specified, submit two sets of selection charts or chips.
F. Verification Samples: Submit samples showing colors and finishes specified.
G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
H. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.
B. Store under cover and elevated above grade.

1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dimensional Letter Signs:
   1. A.R.K. Ramos; www.arkramos.com.
   2. Gemini Inc.: www.geminisignproducts.com.
   3. Inpro Corporation: www.inprocorp.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: 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 restrictive requirements.

2.03 DIMENSIONAL LETTERS

A. Applications: Interior.

1. Use individual metal letters.
2. Mounting Location: Interior as indicated on drawings.

B. Metal Letters:
1. Material: Aluminum casting.
2. Thickness: Manufacturer's standard for letter size.
3. Letter Height: As indicated on drawings.
4. Text and Typeface:
   a. Character Font: As indicated on drawings.
   b. Character Case: As indicated on drawings.
5. Finish: Anodized.
6. Color: Design Intent: Brushed Stainless Anodized. Architect to select from manufacturer's full line.
7. Mounting: Concealed screws.

2.04 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install with horizontal edges level.
C. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.15 - FRP-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. FRP-clad toilet compartments.

1.02 ABBREVIATIONS

A. FRP: Fiberglass reinforced plastic.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
E. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
F. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2014.
G. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics; 2017 (Reapproved 2023).
H. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging; 2020.
I. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
J. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
K. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2018).
L. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
M. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.
N. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact); 2016.
O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
P. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with placement of support framing and anchors in walls and ceilings.
   2. Coordinate the work with floor drain locations.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on panel construction, hardware, and accessories.
C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.
   1. Indicate reinforcement locations for partition-mounted grab bars and surface-mounted toilet accessories.
   2. Show floor drain locations.
D. Samples:

1. Submit 3 samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.
2. Submit 3 sample sets of hardware and accessories indicating material and finish; each set to include door latch, hinge, and panel bracket.

E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

F. Test Reports: Show compliance to specified surface burning characteristics requirements.

G. Maintenance Data: Include data on regular cleaning.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Door Hinges: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
3. Door Latch, Strike, and Keeper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
4. Door Bumper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
5. Door Pull: Quantity equal to 2 percent of total installed, but not less than 2; including fasteners.
6. Fasteners: Quantity equal to 2 percent of each fastener type and size installed, but not less than 10 fasteners of each type and size.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.

B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package partition panels and material as required to prevent damage before installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide 10 year warranty against defects in workmanship and materials, including breakage and corrosion.

C. Provide limited lifetime warranty against failure of corner joinery, core deterioration, delamination or bubbling of panel skin, and fiberglass corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. FRP-clad Toilet Compartments:

1. Special-Lite, Inc.: www.special-lite.com.
2. Substitutions: Section 01 6000 - Product Requirements.

2.02 FRP-CLAD TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of FRP-clad foam core panels with extruded aluminum framing, floor-mounted headrail-braced.

1. Accessibility: Comply with ICC A117.1 and ADA Standards.
2. Surface Burning Characteristics:
   a. Class C per ASTM E84; flame spread 25, maximum, and smoke developed 450, maximum.

B. Panel Construction: Extruded aluminum perimeter framing with poured-in-place foam core and FRP face sheets.

1. Framing: Extruded aluminum, ASTM B221, alloy 6063, temper T5.
   a. Channel profile with integral reglets to accept FRP face sheet on both sides of panel.
      1) Channel shall secure face sheets in place with flush appearance.

2) Provide mitered corners, mechanically fastened with stainless steel fasteners.

2. Foam Core: Poured-in-place foam.
   a. Manufacturer's standard polyurethane foam.
      1) Density: 5 pcf; ASTM D1622/D1622M.
      2) Compressive Strength: 60 psi; ASTM D1621.
      3) Tensile and Tensile Adhesion Properties: ASTM D1623.
         (a) FRP Facer, 3 inches square: 53 psi, minimum.
         (b) FRP Facer, 5 inches square: 104 psi, minimum.
      4) Thermal and Humid Aging: ASTM D2126; volume change at 158 degrees F and 100 percent humidity; 13 percent, maximum at 14 days.
3. Face Sheets: Fiberglass reinforced plastic (FRP).
   a. Thickness: 0.090 inch.
   b. Texture: Pebble grain.
   c. Color: Design Intent: Black.
   d. Performance:
      1) Flexural Strength: 8,500 psi, ASTM D790.
      2) Flexural Strength: 5,000 psi, ASTM D638.
      3) Barcol Hardness: 35, ASTM D2583.
      4) Izod Impact: 6 ft-lb per in, ASTM D256
      5) Gardner Impact Strength: 30 in-lb, ASTM D5420.
      6) Water Absorption: 0.16 percent, maximum after 24 hours at 77 degrees F, ASTM D570.
      7) Taber Abrasion Resistance: Taber test, CS-17 wheels, 1,000g weight, 25 cycles; 0.01 percent maximum weight loss.

C. Doors:
   1. Thickness: 1-1/4 inch.
   2. Width: 24 inch, unless otherwise indicated.
   3. Width for Handicapped Use: 36 inch, out-swinging, unless otherwise indicated.
   4. Height: 58 inch.

D. Panels:
   1. Thickness: 1-1/4 inch.
   2. Height: 58 inch.
   3. Widths: As indicated.

E. Pilasters:
   1. Thickness: 1-1/4 inch.
   2. Width: As required to fit space; minimum 3 inch.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed aluminum ASTM B209, 4 inch high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Extruded anodized aluminum with anti-grip profile.

C. Wall, Pilaster, and Urinal Screen Brackets: Aluminum; continuous type.
   1. Provide full height T-shaped brackets at walls.
   2. Provide full height T-shaped brackets at urinal screens.
   3. Provide U and H-shaped brackets at all other locations.

D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.

E. Hardware:
   1. Continuous Hinges: Full mortise continuous aluminum hinge, gravity self-positioning.
   2. Door Latch: Aluminum strike and slide-type latch; surface-applied and through bolted.
      a. Latches shall have exterior emergency access feature.
   3. Doorstop: Manufacturer's standard hollow bulb type.
      a. Install full length door stop to pilasters; for outswinging doors, apply stop to door.

4. Door Pull: Manufacturer's standard pull; install on outswinging doors and all ADA/barrier free doors.
5. Coat hook with rubber bumper; one per compartment, mounted on door.

2.04 ALUMINUM FINISHES

A. Class I Natural Anodized Finish: Clear anodic coating; AAMA 611, minimum dry film thickness 0.7 mils.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify correct spacing of and between plumbing fixtures.
C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
C. Align tops of doors and panels.
D. Attach panel brackets securely to walls using anchor devices.
E. Wall fasteners shall be located at masonry and tile joints; do not penetrate masonry or tile faces.
F. Align wall brackets and pilaster brackets.
G. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
H. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.
B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, and anchorage details.
C. Shop Drawings: Include plans, elevation, sections, and attachment details.
D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
   1. For each type and finish of corner guard, submit 3 samples, 12 inches long.
E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Corner Guard Covers: Quantity equal to 2 percent of total installed, but not less than 4; in same lengths as installed units.
G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
B. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
C. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 PRODUCT TYPES

A. CG1Corner Guards - Plastic, Flush Mounted:
   1. Material: One of the following, with full height extruded aluminum retainer:
      a. High impact vinyl.
      b. Polyethylene terephthalate (PET or PETG); PVC-free.
   2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Width of Wings: 3 inches.
   5. Corner: Radiused, 1/4 inch.
   6. Corner Angle: 90 degrees; and as otherwise indicated.
   7. Color: Architect to select from manufacturer's standard colors.

8. Projection From Wall to Outside of Guard: 3/8 inch, maximum.
9. Length: One piece.
   a. Extend floor to ceiling; unless otherwise indicated.
10. Preformed end caps.
11. Products:
    a. Construction Specialties, Inc; Model SFS-20N: www.c-sgroup.com.
    b. Inpro Corp; Model 150F Flush Mount: www.inprocorp.com.
    c. Koroseal Interior Products, LLC; Model R400-Series: www.koroseal.com.
    d. Pawling Corporation; Model CGT-7: www.pawling.com.
    e. Substitutions: See Section 01 6000 - Product Requirements.

B. CG2 Corner Guards - Plastic, Flush Mounted:
1. Material: One of the following, with full height extruded aluminum retainer:
   a. High impact vinyl.
   b. Polyethylene terephthalate (PET or PETG); PVC-free.
2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
4. Width of Wings: 3 inches.
5. Corner: Radiused, 1/4 inch.
6. Corner Angle: 135 degrees; and as otherwise indicated.
7. Color: Architect to select from manufacturer's standard range.
8. Projection From Wall to Outside of Guard: 3/8 inch, maximum.
9. Length: One piece.
   a. Extend floor to ceiling; unless otherwise indicated.
10. Preformed end caps.
11. Products:
    a. Construction Specialties, Inc; Model SFS-20N: www.c-sgroup.com.
    b. Inpro Corp; Model 150F Flush Mount: www.inprocorp.com.
    c. Koroseal Interior Products, LLC; Model R400-Series: www.koroseal.com.
    d. Pawling Corporation; Model CGT-7: www.pawling.com.
    e. Substitutions: See Section01 6000-Product Requirements.

C. CG3 Corner Guards - Plastic, Surface Mounted:
1. Material: One of the following, with full height extruded aluminum retainer:
   a. High impact vinyl.
   b. Polyethylene terephthalate (PET or PETG); PVC-free.
2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
4. Width of Wings: 3 inches.
5. Corner: Radiused, 1/4 inch.
6. Corner Angle: 90 degrees; and as otherwise indicated.
7. Color: As selected from manufacturer's standard colors.
8. Projection From Wall to Outside of Guard: 3/8 inch, maximum.
9. Length: One piece.
   a. Height: 48 inches.
10. Products:
    a. Construction Specialties, Inc; Model SM-20AN: www.c-sgroup.com.
    b. Inpro Corp; Model 150 High Impact: www.inprocorp.com.
    c. Koroseal Interior Products, LLC; Model G200-Series: www.koroseal.com.
    d. Pawling Corporation; Model CG-10: www.pawling.com.
    e. Substitutions: See Section01 6000-Product Requirements.

2.02 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work of this Section.

B. For flush mounted corner guards, verify that gypsum board recess is properly sized.

C. Verify that substrate surfaces for adhered items are clean and smooth.

1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard 4 inches above finished floor to ceiling; unless otherwise indicated.

C. Corner Guards - Plastic, Surface Mounted:

1. Mechanically fasten continuous metal retainers to substrate.
2. Snap-on plastic finish cover.

D. Corner Guards - Plastic, Flush Mounted:

1. Mechanically fasten continuous metal retainers to substrate; flanges shall overlap gypsum board.
2. Refer to Section 09 2900 - Gypsum Board for finishing flanges with joint compound.
3. Snap-on plastic finish cover.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.
B. Electric hand dryers.
C. Diaper changing stations.
D. Utility room accessories.

1.02 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
D. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2023.
E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
G. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
C. Samples: When requested by Architect.
    1. Submit 3 sample for each color and finish, 2 by 2 inch in size.
D. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
E. Operation and Maintenance Data: Include operating procedures and recommended cleaning methods.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Hand Dryer Filters: For units with filters, provide quantity equal to 2 filters per unit installed. .

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package toilet, bath, and laundry accessories as required to prevent damage before installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Mirrors: Provide 15 year warranty against silver spoilage.

C. Electric Hand Dryers: Provide 5 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design:
   1. Commercial Toilet, Shower, and Bath Accessories, including Utility Room Accessories: Provide product indicated or a comparable product by one of the following:
      a. American Specialties, Inc, (ASI): www.americanspecialties.com.
      b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
      c. Bradley Corporation: www.bradleycorp.com.
      d. Substitutions: Section 01 6000 - Product Requirements.
   2. Electric Hand Dryers: Provide product indicated or a comparable product by one of the following:
      a. American Specialties, Inc, (ASI): www.americanspecialties.com.
      b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
      c. Bradley Corporation: www.bradleycorp.com.
      d. Excel Dryer Inc.: www.exceldryer.com.
      e. World Dryer Corp.: www.worlddryer.com.
      f. Substitutions: Section 01 6000 - Product Requirements.
   3. Diaper Changing Stations: Provide product indicated or a comparable product by one of the following:
      a. American Specialties, Inc, (ASI): www.americanspecialties.com.
      b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
      c. Bradley Corporation: www.bradleycorp.com.
      d. World Dryer Corp.: www.worlddryer.com.
      e. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
C. Stainless Steel Sheet: ASTM A666, Type 304.
D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
F. Zinc Alloy: Die cast, ASTM B86.
G. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser - Owner Furnished, Contractor Installed.
B. Paper Towel Dispenser: Owner Furnished, Contractor Installed.
C. Waste Receptacle: Owner Furnished, Contractor Installed.
D. Soap Dispenser: Owner Furnished, Contractor Installed.
E. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.

2. Size: As indicated on drawings.
3. Frame: Angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
5. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-290.

F. Grab Bars: Stainless steel, smooth surface.
1. Standard Duty Grab Bars:
a. Push/Pull Point Load: 250 pound-force, minimum.
b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
c. Finish: Satin, slip-resistant surface.
d. Length and Configuration: As indicated on drawings.
e. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6806 Series.

G. Combination Sanitary Napkin/Tampon Dispenser: Owner Furnished, Contractor Installed.

H. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, removable receptacle.
1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-270.

I. Robe Hook - Single: Stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-76717.

2.05 ELECTRIC HAND DRYERS

A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
1. Operation: Automatic, sensor-operated on and off.
2. Mounting: Surface mounted.
a. Maximum Projection From Wall: 4 inches.
3. Cover: Epoxy painted steel or die-cast zinc alloy.
a. Color: White.
b. Tamper-resistant screw attachment of cover to mounting plate.
c. Screened or shielded air intake.
d. Screen or shield to prevent access to motor/heater.
4. Air Flow: 70 CFM, minimum.
5. Noise: 70, maximum, 39 inches from unit; with hands under nozzle.
6. Total Wattage: 1000 W, maximum.
7. Runtime: 60 to 90 seconds, maximum.
8. Supply Voltage: 240 V, single phase, 60 Hz, nominal, unless otherwise indicated.
9. Warranty: 10 years.
10. Basis-of-Design Product: Bobrick Washroom Equipment.; QuietDry Series Terra Dry B-7180: www.bobrick.com. Provide the basis-of-design product or one of the following:
a. Substitutions: Section 01 6000 - Product Requirements.

2.06 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Wall-mounted, horizontal, folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Material: Polyethylene.
2. Mounting: Surface.
3. Color: Standard color as selected by Architect.
4. Minimum Rated Load: 250 pounds.
5. Include an integral bed liner dispenser; 50 liner capacity.
6. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; KB300-SS

2.07 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch diameter.
   2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
   3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
   4. Length: 36 inches.
   5. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-224.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify exact location of accessories for installation.
C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 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 indicated and as required by accessibility regulations.
D. Where possible, locate wall fasteners at masonry and tile joints; do not penetrate masonry or tile faces.

3.03 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.
B. Fire extinguisher cabinets.

1.02 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
B. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
C. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and anchorage details.
C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinquishers, mounting measurements for wall bracket, and accessories required for complete installation.
D. Samples: When requested by Architect.
   1. Submit 3 sample for each color and finish, 2 by 3 inch in size.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Fire Extinguishers: 5 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
   2. Croker Division of Fire-End and Croker Corp.: www.croker.com.
   3. Larsen's Manufacturing Co: www.larsensmfg.com.
   4. Nystrom, Inc: www.nystrom.com.
   5. Potter-Roemer: www.potterroemer.com.
   6. Substitutions: See Section 01 6000 - Product Requirements.
B. Fire Extinguisher Cabinets and Accessories:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
   2. Croker Division of Fire-End and Croker Corp.: www.croker.com.
   3. Larsen's Manufacturing Co: www.larsensmfg.com.
   4. Nystrom, Inc: www.nystrom.com.
   5. Potter-Roemer: www.potterroemer.com.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or testing firm acceptable to authorities having jurisdiction for purpose specified and as indicated.
B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 10 pound.
      a. UL Rating: 4A-60B:C.
   3. Finish: Baked polyester powder coat, red color.
   4. Minimum Operational Temperature: Minus 65 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
B. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; minimum 0.036 inch (20 gage) thick base metal.
C. Fire Rated Cabinet Construction: Fire rating equal to wall in which installed.
   1. Primed steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
      a. Minimum Thickness: 0.036 inch (20 gage).
D. Cabinet Configuration: Recessed and semi-recessed type.
   1. Size to accommodate fire extinguisher.
   2. Trim - Recessed Cabinets: Flat square edge, with minimum 1-3/4 inch wide face. Stainless steel.
   3. Projected Trim - Semi-Recessed Cabinets: Returned to wall surface, with 2-1/2 inch rolled-edge projection, and 1-3/4 inch wide face. Stainless steel.
   4. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim.
E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with roller type catch. Hinge doors for 180 degree opening with continuous piano hinge.
   1. Metal: Stainless steel.
F. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
   1. Style: Vertical duo panel glazing.
G. Door Pull: Manufacturer's standard flush/recessed pull handle.
H. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
I. Fabrication: Weld, fill, and grind components smooth.
J. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
K. Finish of Cabinet Interior: White; powder coat.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, painted black. Sized for fire extinguishers specified.
B. Lettering: “FIRE EXTINGUISHER” diecut self-adhering black, equally spaced, lettering; provide in accordance with authorities having jurisdiction (AHJ).
   1. Locations: Unless otherwise indicated:
      a. Fire Extinguisher Cabinets: Locate on door.
         1) Lettering shall be applied at the factory.
      b. Wall brackets: Locate above fire extinguisher and bracket.
   2. Orientation: Vertical.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install cabinets and fire extinguisher brackets plumb and level at mounting heights indicated and in accordance with authorities having jurisdiction (AHJ).
C. Secure rigidly in place.
D. Place extinguishers in cabinets and on wall brackets.
E. Apply fire extinguisher lettering to walls above wall bracket mounted fire extinguishers in accordance with authorities having jurisdiction (AHJ).
F. Adjust cabinet doors for smooth operation.

3.03 PROTECTION

A. Protect installed fire protection specialties from damage due to subsequent construction operations.

END OF SECTION

SECTION 12 2400 - WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manual roller shades.

1.02 REFERENCE STANDARDS

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

B. Sequencing:

1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
2. Do not install shades until final surface finishes and painting are complete.

1.04 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

1. For schedule, use same designations as indicated on Drawings.

D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

F. Samples:

1. Roller Shade Finishes: Submit 3 samples 2 by 3 inches in size for each color selected.
2. Shade Material: Submit 3 samples, 4 by 4 inches in size, for each type, color, and finish.

G. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

H. Window Shade Samples: Representative of types in the project.

1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated. Include all related accessories such as valances.

I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Drive Chain: Quantity equal to 2 percent of total installed, but not less than 100 lineal feet.
3. Clutch Operator: Quantity equal to 2 percent of total installed, but not less than 2 units.
4. Mounting Brackets: Quantity equal to 2 percent of total installed, but not less than 2 pair.

L. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.

1.06 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
   1. Full-sized mock-up may become part of the final installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: 10 years, excluding drive chains.
   2. Electronic Control Equipment: 5 years.
   3. Fabric: 10 years.
   4. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roller Shades:
   1. Draper, Inc.: www.draperinc.com.
   2. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
   3. Legrand North America, LLC/Solarfective: www.legrand.us/solarfective.aspx.
   4. Levolor: https://commercial.levolor.com.
   5. Lutron Electronics Co. Inc./Contract Roller Shades: www.lutron.com
   6. MechoShade Systems, LLC: www.mechoshade.com.
   7. Silent Gliss Inc.: www.silentglissamerica.com.
   8. Substitutions: See Section 01 6000 - Product Requirements.
B. Provide roller shades by one manufacturer from a single source

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.
B. Roller Shades Type A: Manual, single roller, light-filtering.
   1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: As indicated.
      d. Size: As indicated on drawings.
      e. Fabric: RSF- 1
      f. Finishes:
         1) For metal components exposed to view provide manufacturer's standard baked enamel finish.
         2) Colors of Metal and Plastic Components Exposed to View: Standard color as selected by Architect.
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Stamped steel.

3. Roller Tubes: As required for type of shade operation.
   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 or double sided adhesive tape.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Exposed aluminum bottom bar, flat profile with closed ends.
5. Manual Operation:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
      1) Chain Material: Provide nickel-plated metal or stainless steel.
   c. Chain Retainer:
      1) Manufacturer's standard clip.
6. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.
      1) Profile: Square.
   b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
   c. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric RSF- 1: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Products: Provide one of the following:
      a. Mermet Corporation: E Screen: www.mermetusa.com.
      b. Phifer, Inc.: SheerWeave 2410: www.phifer.com.
      c. Substitutions: Not permitted.
   2. Material: Vinyl coated polyester.
   3. Performance Requirements:
      a. UV Blockage: 95 percent, minimum.
      b. Flammability: Pass NFPA 701 large and small tests.
      c. Fungal Resistance: No growth when tested according to ASTM G21.
   4. Openness Factor: 3 percent.
   5. Roll Width: 63 inches, minimum.
   6. Color: Standard color as selected by Architect.

2.04 ROLLER SHADE FABRICATION

A. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.
   3. Horizontal Dimensions - Outside Mounting: Extend shades 2 inches beyond jambs on each side.
B. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.
B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 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 3216 - MANUFACTURED PLASTIC LAMINATE-CLAD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured plastic laminate casework.
B. Miscellaneous pieces including tables and mobile cabinets.
C. Countertops.- In Section 12 3600 Countertops

1.02 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation, and bottoms of cabinets less than 30 inches above finished floor.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ANSI A208.1 - American National Standard for Particleboard; 2022.
C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
H. BHMA A156.18 - Materials and Finishes; 2020.
I. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
J. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
L. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 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.
B. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.
C. Coordinate the work with placement of concealed framing, blocking, and reinforcements that support casework.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each product. Include component dimensions, configurations, construction details, joint details, attachments.
C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include filler panels, rough-in and anchors, reinforcements, and blocking, placement dimensions and tolerances, clearances required, and keying information.
    1. Indicate manufacturer's catalog number for each unit of casework.

2. Indicate plumbing locations and electrical service locations.

D. Samples:
   1. Plastic Laminate: Submit 3 samples 3 by 6 inches in size showing each color, texture, and finish selected.
   2. Edge Banding: Submit 3 samples 6 inches in length showing each color and finish selected.
   3. Solid Surfacing:Submit 3 samples 4 by 4 inches in size, for each type, color, pattern, and finish.

E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

F. Casework Samples: Representative of types in the project.
   1. To be provided only upon request of Architect.
      a. Base Cabinet: Cabinet with drawer and door and specified hardware.
      b. Wall Cabinet: Cabinet with shelves and supports, door and specified hardware.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

I. Maintenance Data: Manufacturer's recommendations for care and cleaning.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Door Hinges: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
   3. Door Catches: Quantity equal to 2 percent of total installed, but not less than 5, includes fasteners.
   4. Door Pulls: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
   5. Shelf Supports: Quantity equal to 2 percent of total installed, but not less than 10.
   6. Drawer Slides: For each size and type, quantity equal to 2 percent of total installed, but not less than 2 paris; includes fasteners.
   7. Locks: For each type, quantity equal to 2 percent of total installed, but not less than 2; includes fasteners.
   8. Grommets: Quantity equal to 2 percent of total installed, but not less than 5.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
   1. Licensed under Architectural Woodwork Institute (AWI) Quality Certification Program (QCP).

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than 5 years of documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation.

B. Environmental Requirements: Do not deliver casework until the following conditions have been met:
   1. Building has been enclosed (windows and doors sealed and weather-tight).
   2. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place and will remain operating.
   3. Painting and other “wet work” construction is complete in the casework areas.

C. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.

D. Storage:

1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the above environmental requirements.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion. Defects include, but are not limited to:

1. Delamination of components.
2. Failure of adhesives.
3. Failure of hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Catalog numbers indicated on Drawings are for products manufactured by TMI Systems Design Corporation: www.tmisystems.com.

1. Provide either the indicated "Basis of Design" products or equivalent products from one of the following:
   a. Advanced Cabinet Systems: www.advancedcabinetsystems.com.
   b. Case Systems: www.casesystems.com.
   c. Stevens Industries, Inc.: www.stevensind.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.

B. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.02 PERFROMANCE REQUIREMENTS

A. Accessibility: Comply with ICC A117.1 and ADA Standards.

2.03 MATERIALS

A. Casework Adhesives: As recommended by casework manufacturer.

B. Laminate Adhesive: Type recommended by casework manufacturer to suit application.

C. Wood-based Materials - General:

1. Maximum Moisture Content: 7 percent.

D. Hardwood Plywood: HPVA HP-1, particleboard core.

E. Particleboard: ANSI A208.1, Grade M-2.

1. Moisture resistant where indicated.

F. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.

1. Moisture resistant where indicated.

G. Laminates:

1. High-Pressure Decorative Laminate (HPDL); NEMA LD 3; Grades as indicated.
2. Thermally Fused Laminate (TFL) : Melamine resin; NEMA LD 3, Grade VGL.

H. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness.

1. 0.118 inch (3 mm) thick at doors, drawer fronts, and countertops.
2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.

I. Tempered Glass: Annealed float glass ASTM C1036, Type 1 (Transparent Flat), Class 1 (Clear), Quality Q3; fully tempered per ASTM C1048, Kind FT. Complying with ANSI Z97.1.

1. Glass Thickness: 1/4 inch, minimum.
2. Exposed Edges: Ground smooth.

2.04 HARDWARE AND ACCESSORIES

A. Hardware and Accessories, General:

1. Cabinet Hardware: Comply with BHMA A156.9, types as indicated for quality grade specified.
   a. Finishes:

1) Exposed Hardware: Provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finishes:
   (a) Satin Stainless Steel: BHMA 630.
   (b) Satin Chromium Plated: BHMA 626.
2) Concealed Hardware: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2. Provide all fasteners, hardware and accessories for a complete installation including:
   a. Undercounter plastic laminate support panels or metal support brackets.
   b. Free-standing table hardware.

B. Hinges: Semiconcealed type, 5 knuckle, institutional grade, hospital tip, 2-3/4 inch overlay, 270 degree opening, 3 way adjustment, 0.095 inch gage, steel with satin finish, Grade 1.
   1. Provide two (2) hinges for doors less than 36 inches high.
   2. Provide three (3) hinges for doors 37 inches to 54 inches high.
   3. Provide four (4) hinges for tall cabinet doors 55 inches to 84 inches high.

C. Door Catches: Heavy-duty magnetic or roller type catch and strike plate.
   1. Doors up to 48 inches high shall have single catch mounted at bottom door edge.
   2. Doors over 48 inches high shall have catch at both the top and bottom edges of door.

D. Pulls:
   1. Type: Back-mounted wire pulls, standard U-shape style.
      a. Material: Solid aluminum, stainless steel, or chrome-plated brass.
      b. Overall Size: 4-1/2 inches wide by 1 inch deep.
   2. Provide as follows:
      a. Doors: Single pull.
      b. Drawers up to 24 inches Wide: Single pull.
      c. Drawers over 24 inches Wide: Two pulls.

E. Drawer Slides: Epoxy coated with nylon rollers or zinc plated with steel ball-bearings; self-closing with positive stop both directions. Load rating at full extension as follows:
   1. Drawers less than 2 inches deep: 50 lbs.
   2. All Drawers 2 to 4 inches deep: 100 lbs.
   3. File Drawer and Drawers over 4 inches deep: 150 lbs.

F. Adjustable Shelf Supports: Double-pin clear polycarbonate shelf rests with shelf anti-tipping feature complying with BHMA A156.9, Type B04013. Designed to mount into pre-drilled holes in casework sides. Each shelf rest shall support 200 lbs, minimum.

G. Locks: Removable core, disc tumbler, cam style lock with strike for drawers and doors. At other locations, use lock style to suit application.
   1. Door Locks: BHMA A156.11, E07121.
   2. Drawer Locks: BHMA A156.11, E07041.
   3. Provide locks on every doors and drawers per room.
      a. All locks within a room shall be keyed alike and different than adjacent rooms. All locks on the Project shall be master keyed.
         1) Provide 2 keys for each room and three 3 master keys.

H. Sliding Door Track: Manufacturer's standard anodized aluminum double channel assembly with track/door rollers; type and size to suit sliding-doors.

I. Grommets: 2 inch outside diameter, molded-plastic grommets and matching plastic caps with wire passage slot.
   1. Color: Black.

J. Coat Rods:
   1. Rod: Minimum 1 inch diameter steel tube; minimum wall thickness 0.075 inch (14 gage).
   2. Brackets: Steel mounting brackets.

K. Casters: Non-marking, soft, rubber wheels with ball bearing assembly.

1. Brakes: Provide 2 brakes, minimum, per mobile unit.
2. Load Capacity: 200 pounds, minimum, per caster.

2.05 MANUFACTURED PLASTIC LAMINATE CASEWORK

A. Cabinet Construction - General:
   1. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
      a. Laminate-clad panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels.
      b. Provide cabinet sizes and configurations as indicated on Drawings.
   2. Quality Standard: AWI/AWMAC/WI (AWS), unless noted otherwise.
      a. Grade: Premium.
   3. Design Style: Flush overlay, frameless construction.
B. Core Material: Particleboard or MDF, unless otherwise indicated.
C. Component Thicknesses: Not less than the following.
   1. General component thicknesses unless otherwise indicated:
      a. Base Cabinets: 3/4 inch.
      b. Wall Cabinets: 3/4 inch.
      c. Tall Cabinets: 3/4 inch.
   2. Cabinet Backs:
      a. 1/4 inch thick.
   3. Shelves:
      a. 36 inches or less in length: 3/4 inch thick, unless otherwise indicated.
      b. Over 36 inches in length: 1 inch thick.
   4. Doors:
      a. Height 48 inches or less: 3/4 inch thick.
      b. Height over 48 inches: 1 inch thick
   5. Drawer Subfronts, Sides and Backs: 1/2 inch thick.
   6. Drawer Bottoms:
      a. 24 inches or less in width: 1/4 inch thick.
      b. Over 24 inches in width: 1/2 inch thick.
D. Exposed Materials:
   1. Laminates: High-Pressure Decorative Laminate (HPDL), Grade VGS.
   2. Edgebanding: Provide specified edgebanding unless noted otherwise.
E. Semi-Exposed Materials:
   1. Laminates: Thermally Fused Laminate (TFL).
   2. Edgebanding: Provide specified edgebanding unless noted otherwise.
F. Concealed Materials:
   1. Laminates: High-Pressure Decorative Laminate (HPDL), Grade BKM, BKV, BKL, or CLS as appropriate for conditions.
G. Joints doweled, glued and screwed.
H. Drawer Materials and Construction: Hardwood veneer plywood. Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Drawer Construction Method: Multiple dovetailed or doweled; with captured bottoms.
I. All cabinets shall be manufactured with balance construction; apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
J. Laminates: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
K. Edgebanding: Do not use more than one piece for any single length.
L. Glazing for Doors: Clear tempered glass.
M. Aprons and Modesty Panels: Provide panels matching construction and finish of casework.

N. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
O. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
P. Provide cutouts for electrical receptacles and other utility, mechanical, and electrical components as indicated.
Q. Access Panels: Provide as required for maintenance of utility service and mechanical and electrical components.
R. Mobile Cabinets: Same construction as fixed base cabinets, with modifications.
1. Toe kick space eliminated.
2. Cabinet underside reinforced as is standard with the manufacturer to provide caster mounting points.
a. Four casters, minimum.
3. For cabinets with drawers, include a counterweight to prevent the cabinet from tipping when one drawer is opened.

2.06 COUNTERTOPS

A. Countertops: As specified in Section 12 3600.

2.07 ACCESSORIES

A. 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.
B. Countertop Adhesives: As recommended by solid surfacing manufacturer.

2.08 COLORS AND FINISHES

A. Laminate Colors, Patterns, and Finishes:
1. High-Pressure Decorative Laminates:
a. PL1 - Wisonart; Steel Mesh 4879-38.
b. PL2 - Formica; Classic White 9244-58.
c. PL3 - Formica; Natural Recycled Kraft 09684-58.
2. Thermally Fused Laminates:
a. Color: White.
B. PVC Edgebanding Colors:
1. Color(s): Matching adjacent laminate.

PART 3 EXECUTION

3.01 PREPARATION

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.02 EXAMINATION

A. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment.
B. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.
C. Verify adequacy of support framing and anchors.
D. Verify that service connections are correctly located and of proper characteristics.

3.03 CASEWORK INSTALLATION

A. Perform installation in accordance with manufacturer's instructions.

B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.

G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.

1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches on center, and at sides of cabinets with not less than two fasteners per side.

H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches on center.

I. Install hardware uniformly and precisely.

J. Replace units that are damaged, including those that have damaged finishes.

3.04 COUNTERTOP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.

1. Variation From Level/Horizontal: 1/8 inch in 10 feet, maximum.
2. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
3. Field Joints: 1/16 inch wide, maximum.
4. Do not exceed 1/64 inch difference between planes of adjacent units.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Attach plastic laminate countertops using concealed screws with minimum penetration into substrate of 5/8 inch.

1. Secure back/end splashes to countertop and vertical substrates with waterproof adhesive.

E. Attach solid surfacing countertops to subtops using compatible adhesive.

1. Secure back/end splashes to countertop and vertical substrates with waterproof adhesive.

F. Attach stainless steel countertops using concealed stainless steel fasteners and clips.

3.05 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.06 CLEANING

A. Clean casework and other installed surfaces thoroughly.

3.07 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

SECTION 12 3600 - COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.
B. Countertops for manufactured casework.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.
B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
F. AWI (QCP) - Quality Certification Program; Current Edition.
G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
H. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
I. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
K. PS 1 - Structural Plywood; 2009.
L. SEFA 2 - Installations; 2010.
M. SEFA 3 - Laboratory Work Surfaces; 2010.
N. WI (CCP) - Certified Compliance Program (CCP); Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.
C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
G. Installation Instructions: Manufacturer's installation instructions and recommendations.
H. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.04 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. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.

2. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com/#sle.
3. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
4. Provide designated labels on shop drawings as required by certification program.
5. Provide designated labels on installed products as required by certification program.
6. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
B. Quality Standard: SEFA 3 for laboratory worksurfaces.
C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
    1. Flat Sheet Thickness: 1/2 inch, minimum.
    2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
        a. Manufacturers:
            1) Dupont; Corian: www.corian.com/#sle.
        b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
        c. Color and Pattern (SS2): Excavage.
    3. Other Components Thickness: 1/2 inch, minimum.
    4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
    5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 MATERIALS

A. Extruded Aluminum: ASTM B211/B211M, 6463 alloy, T5 temper.
B. Wood-Based Components:
    1. Wood fabricated from old growth timber is not permitted.
C. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
D. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.
E. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
F. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
G. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Apply sealer products in accordance with manufacturer's written instructions.

C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

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

END OF SECTION

SECTION 20 0500 - MECHANICAL GENERAL REQUIREMENTS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 INDUSTRY STANDARDS 1
1.04 PERFORMANCE REQUIREMENTS 3
1.05 QUALITY ASSURANCE 3
1.06 CODES, PERMITS AND FEES 3
1.07 DRAWINGS 4
1.08 MATERIAL AND EQUIPMENT MANUFACTURERS 4
1.09 INSPECTION OF SITE 5
1.10 ITEMS REQUIRING PRIOR APPROVAL 5
1.11 ACTION SUBMITTALS 5
1.12 INFORMATIONAL SUBMITTALS 5
1.13 CLOSEOUT SUBMITTALS 6
1.14 INSTRUCTION OF OWNER PERSONNEL 7
1.15 WARRANTY 7
PART 2 PRODUCTS (NOT APPLICABLE) 8
PART 3 EXECUTION 8
3.01 REFRIGERANT HANDLING 8
3.02 TEMPORARY SERVICES 8
3.03 WORK INVOLVING OTHER TRADES 8
3.04 ACCEPTANCE PROCEDURE 8

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.03 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
3. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
4. ABMA - American Boiler Manufacturers Association; www.abma.com.
5. AGA - American Gas Association; www.aga.org.
6. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
7. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
8. ANSI - American National Standards Institute; www.ansi.org.

9. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
10. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
11. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
12. ASTM - ASTM International; www.astm.org.
13. AWS - American Welding Society; www.aws.org.
14. AWWA - American Water Works Association; www.awwa.org.
15. CDA - Copper Development Association; www.copper.org.
16. CGA - Compressed Gas Association; www.cganet.com.
17. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
18. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
19. CSI - Construction Specifications Institute (The); www.csiresources.org.
20. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
21. FM Approvals - FM Approvals LLC; www.fmglobal.com.
22. HI - Hydraulic Institute; www.pumps.org.
23. ICC - International Code Council; www.iccsafe.org.
24. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
25. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
26. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
27. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org
28. NADCA - National Air Duct Cleaners Association; www.nadca.com.
29. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
30. NEBB - National Environmental Balancing Bureau; www.nebb.org.
31. NECA - National Electrical Contractors Association; www.necanet.org.
32. NEMA - National Electrical Manufacturers Association; www.nema.org.
33. NETA - InterNational Electrical Testing Association; www.netaworld.org.
34. NFPA - National Fire Protection Association; www.nfpa.org.
35. NSF - NSF International; www.nsf.org.
36. NSPE - National Society of Professional Engineers; www.nspe.org.
37. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
38. STI - Steel Tank Institute; www.steeltank.com.
39. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
40. UL - Underwriters Laboratories Inc.; www.ul.com.
41. USGBC - U.S. Green Building Council; www.usgbc.org.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 **PERFORMANCE REQUIREMENTS**

A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.05 **QUALITY ASSURANCE**

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.

2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner’s Representatives causes interference.

G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.06 **CODES, PERMITS AND FEES**

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing

authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

D. Refer to Division 22 Section “Domestic Water Piping” for purchase and installation of potable water meters.

1.07 **DRAWINGS**

A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.08 **MATERIAL AND EQUIPMENT MANUFACTURERS**

A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.

D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.09 **INSPECTION OF SITE**

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 **ITEMS REQUIRING PRIOR APPROVAL**

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 **ACTION SUBMITTALS**

A. Submit for review in compliance with Division 01.

B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.

C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned “Rejected”. Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.

D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned “Rejected”.

E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings:

1. Prepare shop drawings to scale for the Architect/Engineer for review.

2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.

3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.

   a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.

   b. Contractor is responsible for:

      1) Dimensions, which shall be confirmed and correlated at the job site.

      2) Fabrication processes and techniques of construction.

      3) Quantities.

      4) Coordination of Contractor's work with all other trades.

      5) Satisfactory performance of Contractor's work.

      6) Temporary aspects of the construction process.

B. Coordination Drawings:

1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Instructional Manuals:

1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.

3. Format: Submit operation and maintenance manuals in the following format:

   a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

      1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

      2) Enable inserted reviewer comments on draft submittals.

4. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:

   a. Routine maintenance procedures.

   b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.

c. Trouble-shooting procedures.

d. Contractor's telephone numbers for warranty repair service.

e. Submittals.

f. Recommended spare parts list.

g. Names and telephone numbers of major material suppliers and subcontractors.

h. System schematic drawings.

B. Record Drawings:

1. Submit record drawings in compliance with Division 01.

2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.

3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

C. Warranties:

1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 **INSTRUCTION OF OWNER PERSONNEL**

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.

E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 **WARRANTY**

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion

following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **REFRIGERANT HANDLING**

A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:

1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.

B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.02 **TEMPORARY SERVICES**

A. Provide temporary service as described in Division 01.

3.03 **WORK INVOLVING OTHER TRADES**

A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.04 **ACCEPTANCE PROCEDURE**

A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.

B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.

D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

E. Operation of the following systems shall be demonstrated:

1. Air Handling Systems.
2. Refrigeration Systems.
3. Heat Pump Loop Water Systems.
4. Domestic Water Booster Systems.
5. Domestic Hot Water Heaters.
6. Domestic Hot Water Mixing Stations.

7. Chemical Treatment Systems.
8. Energy Recovery Systems.
9. Temperature Controls.
10. Building Automation System.
11. Exhaust Systems.

F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

END OF SECTION

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 2
1.03 DEFINITIONS 2
1.04 ACTION SUBMITTALS 2
1.05 INFORMATIONAL SUBMITTALS 2
1.06 QUALITY ASSURANCE 3
1.07 DELIVERY, STORAGE, AND HANDLING 3
1.08 COORDINATION 4
PART 2 PRODUCTS 4
2.01 MANUFACTURERS 4
2.02 PIPE, TUBE, AND FITTINGS 4
2.03 JOINING MATERIALS 4
2.04 PIPE THREAD COMPOUNDS 5
2.05 TRANSITION FITTINGS 6
2.06 DIELECTRIC FITTINGS 7
2.07 MODULAR MECHANICAL SEALS 8
2.08 SLEEVES 8
2.09 ESCUTCHEONS 9
2.10 GROUT 9
2.11 EPOXY BONDING COMPOUND 9
2.12 LEAK DETECTOR SOLUTION 9
2.13 PIPING CONCEALMENT SYSTEM 9
2.14 PIPE PENETRATION ASSEMBLIES 10
PART 3 EXECUTION 10
3.01 PIPING SYSTEMS - COMMON REQUIREMENTS 10
3.02 PIPING JOINT CONSTRUCTION 13
3.03 ACCESS DOORS 15
3.04 EQUIPMENT CONNECTIONS 15
3.05 PIPING CONNECTIONS 16
3.06 INSTALLATION OF PIPE CONCEALMENT SYSTEM 16
3.07 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS 16
3.08 PAINTING 16
3.09 CONCRETE BASES 16
3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES 17
3.11 EPOXY BONDING TO EXISTING MATERIALS 17
3.12 JACKING OF PIPE 17
3.13 ERECTION OF WOOD SUPPORTS AND ANCHORAGES 17
3.14 GROUTING 17
3.15 CUTTING, CORING AND PATCHING 18
3.16 EXCAVATION AND BACKFILLING 18
3.17 FLASHING 18
3.18 LUBRICATION 18
3.19 FILTERS 18
3.20 CLEANING 18

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 22 Section “Domestic Water Piping” for flushing and cleaning of potable water piping.
3. Division 23 Section “Piping Systems Flushing and Chemical Cleaning” for flushing and cleaning of HVAC piping.

1.02 SUMMARY

A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.
5. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
6. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.06 **QUALITY ASSURANCE**

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

D. Comply with NSF 372, “Drinking Water System Components – Lead Content” for potable domestic water piping and components.

E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

F. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:

1. AWS D9.1, "Sheet Metal Welding Code."

G. Structural Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.2, "Structural Welding Code--Aluminum."

3. AWS D1.3, "Structural Welding Code--Sheet Steel."

4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

5. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

H. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

I. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."

J. Installer Qualifications:

1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.

2. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

3. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the

Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.

1. Protect equipment and materials from theft, injury or damage.
2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.08 **COORDINATION**

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.

D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.

1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 **PIPE, TUBE, AND FITTINGS**

A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 **JOINING MATERIALS**

A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.

B. Unions: Pipe Size 2 Inches and Smaller:

1. Ferrous pipe: Malleable iron ground joint type unions.
2. Unions in galvanized piping system shall be galvanized.
3. Copper tube and pipe: Bronze unions with soldered joints.

C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:

1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
2. Copper tube and pipe: Slip-on bronze flanges.

D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.

H. Brazing Filler Metals: Alloys meeting AWS A5.8.

1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.

I. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

K. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

L. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

M. Solvent Cements for Joining ABS Piping: ASTM D 2235.

N. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.

O. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 PIPE THREAD COMPOUNDS

A. General: Pipe thread compounds for the fluid service compatible with piping materials provided.

B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

C. Galvanized Steel: Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds to coat raw carbon steel surfaces, in lieu of subsequent painting. Compounds containing lead are prohibited.

1. Manufacturers:

a. Carboline "Carbo-Zinc 12."

b. Tnemec.

c. Koppers.

D. Steam and Steam Condensate: Graphite and oil or proprietary corrosion inhibited compounds suitable for system temperatures.

1. Manufacturers:

a. Cameron; A Schlumberger Company; Key "Graphite Paste."

b. Other approved.

E. Natural Gas System: Use either of the following:

1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.

a. Manufacturers:

1) Cadillac Plastic.

2) Permacel.

3) Other approved.

2. Lead-free pipe thread compounds suitable for service.

a. Manufacturers:

1) HCC Holdings, Inc.; Hercules Pro Dope.

2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.

3) Oatey; Great Blue Pipe Joint Compound.

4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

2.05 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Dresser Industries, Inc.; DMD Div.

c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.

d. JCM Industries.

e. Smith-Blair, Inc.

f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.

3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.

4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. IPEX Inc. (formerly Eslon Thermoplastics).

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.

b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Fernco, Inc.

c. Mission Rubber Company.

d. Plastic Oddities, Inc.

e. Can-Tex Industries Division of Harsco Corp. “CT-Adaptors”.

f. Joint Inc., “Caulder”.

2.06 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.

D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Capitol Manufacturing Co.

d. GF Piping Systems; George Fischer Central Plastics.

e. Epco Sales, Inc.

f. Pipeline Seal and Insulator, Inc.

g. Watts Water Technologies, Inc.; Watts Regulator Co.

h. Zurn Industries, Inc.; Wilkins Div.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.

1. Manufacturers:

a. ASC Engineered Solutions; Gruvlok Manufacturing; DI-LOK Nipples.

b. Elster Group; Perfection Corp.; ClearFlow.

c. Precision Plumbing Products, Inc.; ClearFlow.

d. Sioux Chief Manufacturing Co., Inc.

e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.

f. Victaulic Co. of America; Style 47 ClearFlow.

2.07 MODULAR MECHANICAL SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.

1. Manufacturers:

a. Advance Products & Systems, Inc.; Innerlynx.

b. Calpico, Inc.

c. Metraflex Co.

d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.08 SLEEVES

A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.

B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.

C. Water Stop: Cast or ductile-iron; fabricated steel; PVC; or rotationally molded HDPE pipe; with plain ends and integral water stop, unless otherwise indicated.

1. Manufacturers:

a. Advance Products & Systems, Inc.; Infinity and Gal-Vo-Plast Sleeves.

b. Calpico, Inc.

c. Metraflex Co.

d. Pipeline Seal and Insulator, Inc.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.09 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type with spring clips.

d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.

e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.11 EPOXY BONDING COMPOUND

A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.

B. Manufacturers:

1. Euco 452 #450; Euclid Chemical Co.

2. Epobond; L & M Construction Chemicals.

3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

A. Commercial leak detector solution for pipe system testing.

B. Manufacturers:

1. American Gas and Chemicals Inc.; Leak Tec.

2. Cole-Parmer Inst. Co.; Leak Detector.

3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.13 PIPING CONCEALMENT SYSTEM

A. Manufacturers:

1. ARSCO Manufacturing Company.

2. JG Innovations Inc.

B. Description: Modular system of support brackets and covers made to protect piping.

C. Brackets: Glass-reinforced nylon.

D. Covers: Galvanized steel sections of length, shape, and size required for size and routing of piping.

2.14 **PIPE PENETRATION ASSEMBLIES**

A. Contractor may choose from one of the following:

B. Pipe Roof Penetration Enclosures

1. Manufacturers:
   a. Pate Company (The); pca Series.
   b. Portal Plus, Inc.
   c. Thybar Corporation; Thycurb.
2. Prefabricated roof curb with:
   a. Minimum 18 gage welded galvanized steel construction.
   b. Integral base plate.
   c. Factory installed insect and decay resistant wood nailer.
   d. EPDM compression molded rubber cap for single or multiple pipes as required. Quantity of molder rubber caps shall be sufficient for no more than one pipe or conduit per cap.
   e. Stainless steel draw-band clamps.

C. Pipe Roof Penetration Hood Assembly

1. Manufacturers:
   a. Pate Company (The); pca Series.
2. Heavy gage aluminum construction.
3. Removable top cover.
4. Fully insulated aluminum mounting base to isolate hood from galvanized curb.
5. Includes prefabricated roof curb with:
   a. Minimum 18 gage welded galvanized steel construction.
   b. Integral base plate.
   c. Factory installed insect and decay resistant wood nailer.

PART 3 EXECUTION

3.01 **PIPING SYSTEMS - COMMON REQUIREMENTS**

A. Refer to piping application schedules on the Drawings.

B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.

C. 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. The Drawings shall be followed as closely as elements of construction will permit.

D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.

E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

H. Clean and lubricate elastomer joints prior to assembly.

I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

J. Install piping to conserve building space and not interfere with use of space.

K. Group piping whenever practical at common elevations.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.

M. Slope piping and arrange systems to drain at low points.

N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.

O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

P. 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.

Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.

R. Do not penetrate building structural members unless specifically indicated on drawings.

S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.

T. Install valves with stems upright or horizontal, not inverted.

U. Provide clearance for installation of insulation and access to valves and fittings.

V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.

W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.

X. Install piping free of sags and bends.

Y. Install fittings for changes in direction and branch connections.

Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:

1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.

2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.

AA. Install piping to allow application of insulation.

BB. Select system components with pressure rating equal to or greater than system operating pressure.

CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections “Hydronic Piping,” “Piping Systems Flushing and Chemical Cleaning,” and “HVAC Water Treatment.”

DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.

EE. Sleeves are not required for core-drilled holes in poured concrete walls.

FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.

GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces of walls.
    a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
    b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
    c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
    d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
    e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

JJ. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.

2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.

KK. Pipe Roof Penetration Enclosures:

1. Coordinate delivery of roof penetration enclosures to jobsite.

2. Locate and set curbs on roof.

3. Framing, flashing, and attachment to roof structure are specified under Division 07.

4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.

LL. Verify final equipment locations for roughing-in.

MM. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 **PIPING JOINT CONSTRUCTION**

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Cut piping square.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.

E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.

G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.

H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.

I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.

J. Provide temperature sensing device thermal wells and similar piping specialty connections.

K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.

L. Locate instrument connections in accordance with manufacturer’s instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.

M. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.

1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.

2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.

R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

S. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

T. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

U. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.

V. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

W. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

X. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

Y. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

Z. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

AA. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.03 ACCESS DOORS

A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section “Access Doors and Frames” for manufacturers and model numbers and additional information.

B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.04 EQUIPMENT CONNECTIONS

A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.

1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer’s submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.

B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.05 **PIPING CONNECTIONS**

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.06 **INSTALLATION OF PIPE CONCEALMENT SYSTEM**

A. Install cover system, brackets, and cover components for piping according to manufacturer's "Installation Manual."

3.07 **EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.

F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.

G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer’s name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.08 **PAINTING**

A. Painting of mechanical systems, equipment, and components is specified in Division 09.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.09 **CONCRETE BASES**

A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.

B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.

D. Field Welding: Comply with AWS D1.1.

3.11 EPOXY BONDING TO EXISTING MATERIALS

A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.

B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.12 JACKING OF PIPE

A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.13 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.14 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.15 **CUTTING, CORING AND PATCHING**

A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.

B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.16 **EXCAVATION AND BACKFILLING**

A. Refer to Division 31 Specification Sections.

B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.

C. Provide all pumping and/or well pointing required for the mechanical work.

D. Provide foundations if required to support underground piping.

E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.17 **FLASHING**

A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.18 **LUBRICATION**

A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.19 **FILTERS**

A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.

B. Immediately prior to final building acceptance by the Owner, Contractor shall:

1. Replace all disposable type air filters with new units.

3.20 **CLEANING**

A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

C. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section “Domestic Water Piping.”

D. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.

E. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION

SECTION 20 0513 - MOTORS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 QUALITY ASSURANCE 2
1.05 DELIVERY, STORAGE, AND HANDLING 2
1.06 COORDINATION 2
1.07 EXTRA MATERIALS 3
PART 2 PRODUCTS 3
2.01 MANUFACTURERS 3
2.02 MOTOR REQUIREMENTS 3
2.03 MOTOR CHARACTERISTICS 3
2.04 POLYPHASE MOTORS 4
2.05 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS 6
2.06 ELECTRONICALLY COMMUTATED MOTOR (ECM) 7
2.07 SINGLE-PHASE MOTORS 7
2.08 ENCLOSED CONTROLLERS 7
2.09 ENCLOSED SWITCHES AND CIRCUIT BREAKERS 7
2.10 FUSES 7
PART 3 EXECUTION 8
3.01 FIELD QUALITY CONTROL 8
3.02 ADJUSTING 8
3.03 CLEANING 8

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
3. Division 20 Section “Variable Frequency Controllers”.
4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
5. Division 26 Section “Enclosed Switches and Circuit Breakers”.
6. Division 26 Section “Enclosed Controllers”.
7. Division 26 Section “Fuses”.

1.02 SUMMARY

A. This Section includes basic requirements for factory-installed motors.

1.03 DEFINITIONS

A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)

B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

C. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.04 **QUALITY ASSURANCE**

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.05 **DELIVERY, STORAGE, AND HANDLING**

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 **COORDINATION**

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:
    a. Magnetic controllers.
    b. Multispeed controllers.
    c. Reduced-voltage controllers.
    d. Solid-state controllers.
    e. Variable frequency controllers.
2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate electrical scope of work to be provided by Division 20, 21, 22, and 23 with this Section, related Division 20, 21, 22, and 23 Specifications, Division 26 Specifications and the Drawings.

C. Electrical work provided under Division 20, 21, 22, and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.

D. Furnished, installed and wired under Division 20, 21, 22, and 23 unless otherwise indicated:

1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.

E. Furnished and installed under Division 20, 21, 22, and 23 and wired under Division 26 unless otherwise indicated:

1. Motors required for mechanical equipment
2. Packaged Self-Contained Equipment:
    a. Provide equipment ready to accept a single electrical service connection.

b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.

3. Variable frequency controllers.

1.07 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.

2. Spare Indicating Lights: Six of each type installed.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Subject to compliance with requirements, provide products by one of the following:

1. Dayton.

2. Toshiba Intl.

3. Baldor Electric/Reliance.

4. Rockwell Automation/Allen-Bradley.

5. Nidec Motor Corporation; U.S. Electrical Motors.

6. Regal Beloit/GE Commercial Motors.

7. Regal Beloit/Leeson.

8. Regal Beloit/Marathon.

9. Siemens.

2.02 **MOTOR REQUIREMENTS**

A. Motor requirements apply to factory-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.

2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.

B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.

C. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.03 **MOTOR CHARACTERISTICS**

A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.

B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. 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.

H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.

I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.04 **POLYPHASE MOTORS**

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
1	80	78.5	--	--

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For “NEMA Premium™” Induction Motors
Rated 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

D. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:

1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.

2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.

3. Fire Pump Motors: NEMA starting Code (KVA Code) B.

J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

1. Finish: Gray enamel.

K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.05 **POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS**

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.

C. Severe-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.06 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Furnish for equipment where specified or scheduled with ECM.

1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

2.07 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.08 ENCLOSED CONTROLLERS

A. Provide enclosed controllers in accordance with requirements specified in Division 26 Section “Enclosed Controllers”.

2.09 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 26 Section “Enclosed Switches and Circuit Breakers”.

2.10 FUSES

A. Provide fuses in accordance with requirements specified in Division 26 Section “Fuses”.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.

B. Prepare for acceptance tests as follows:

1. Check motor nameplates for horsepower, speed, phase and voltage.
2. Check coupling alignment and shaft end play.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control features for proper operation.
5. Verify that current in each phase is within nameplate rating.

C. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.02 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.03 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 20 0516 - PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 PERFORMANCE REQUIREMENTS 1
1.04 ACTION SUBMITTALS 2
1.05 INFORMATIONAL SUBMITTALS 2
1.06 CLOSEOUT SUBMITTALS 2
1.07 QUALITY ASSURANCE 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 FLEXIBLE CONNECTORS 2
2.03 EXPANSION JOINTS 4
2.04 ALIGNMENT GUIDES 6
2.05 SLIDING/GUIDING DEVICES 7
2.06 MATERIALS FOR ANCHORS 7
PART 3 EXECUTION 8
3.01 FLEXIBLE CONNECTOR APPLICATIONS 8
3.02 EXPANSION-JOINT INSTALLATION 8
3.03 PIPE BEND AND LOOP INSTALLATION 9
3.04 SWING CONNECTIONS 9
3.05 ALIGNMENT-GUIDE INSTALLATION 9
3.06 ANCHOR INSTALLATION 9

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. BR: Butyl rubber.

B. CR: Chlorosulfonated polyethylene synthetic rubber (Neoprene).

C. CSM: Chlorosulfonyl-polyethylene rubber (Hypalon).

D. EPDM: Ethylene-propylene-diene terpolymer rubber.

E. NBR: Buna-N/Nitrile rubber.

F. NR: Natural rubber.

G. PTFE: Polytetrafluoroethylene plastic.

1.03 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.04 **ACTION SUBMITTALS**

A. Product Data: For each type of pipe flexible connector, expansion joint and alignment guide indicated.

1.05 **INFORMATIONAL SUBMITTALS**

A. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.

2. Locations of pipe anchors and alignment guides and expansion joints and loops.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.

2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.

3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

1.06 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For pipe expansion joints to include in operation and maintenance manuals.

1.07 **QUALITY ASSURANCE**

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **FLEXIBLE CONNECTORS**

A. Rubber Flexible Connectors/Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods or cables, and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

1. Manufacturers:

a. Flex-Weld, Inc./Keflex.

b. Mason Industries, Inc.; Mercer Rubber Co.

c. Metraflex, Inc.

d. Senior Flexonics, Inc.; Pathway Division.
e. Twin City Hose, Inc.
f. Vibration Mountings & Controls, Inc.

2. Arch Type: Multiple arches.
3. Spherical Type: Multiple spheres.
   a. Working Pressure Ratings for NPS 1-1/2 to NPS 4: 225 psig at 170 deg F.
   b. Working Pressure Ratings for NPS 5 and NPS 6: 225 psig at 170 deg F.
   c. Working Pressure Ratings for NPS 8 to NPS 12: 225 psig at 170 deg F.
   d. Working Pressure Ratings for NPS 14: 150 psig at 170 deg F.
   e. Working Pressure Ratings for NPS 16 to NPS 20: 125 psig at 170 deg F.
   f. Working Pressure Ratings for NPS 24: 110 psig at 170 deg F.
4. Material: EPDM.
5. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
6. Coating: Factory applied Hypalon paint for outdoor applications.

B. PTFE Flexible Connectors/Expansion Joints: Molded PTFE bellows with external reinforcing rings and external limit bolts.
   1. Manufacturers:
      a. Flex-Weld, Inc./Keflex.
      b. Mason Industries, Inc.; Mercer Rubber Co.
      c. Metraflex, Inc.
      d. Senior Flexonics, Inc.; Pathway Division.
      e. Twin City Hose, Inc.
      f. Vibration Mountings & Controls, Inc.
   2. Arch Type: Multiple arches.
   3. End Connections: Full-faced, integral, ductile iron flanges.

C. Metal-Bellows Flexible Connectors: Circular-corrugated-bellows type with external tie rods and compression stops.
   1. Manufacturers:
      a. Adsco Manufacturing, LLC.
      b. Flex-Weld, Inc./Keflex.
      c. Hyspan Precision Products, Inc.
      d. Metraflex, Inc.
      e. Senior Flexonics, Inc.; Pathway Division.
      f. Twin City Hose, Inc.
   2. Metal-Bellows Flexible Connectors for Steel Piping: Multiple-ply 300 Series stainless-steel bellows.
   3. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
   4. Maximum Temperature Rating: 850 deg F.

5. End Connections: Flanged

D. Hose and Braid Flexible Connectors:

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Hose Co., Inc.
   c. Flex-Weld, Inc.
   d. Hyspan Precision Products, Inc.
   e. Metraflex, Inc.
   f. Senior Flexonics, Inc.; Pathway Division.
   g. Twin City Hose, Inc.
2. Flexible Connectors for Copper Piping: Multiple-ply phosphor-bronze corrugated hose with bronze outer braid, copper ferrule, and copper pipe end connections.
3. Flexible Connectors for Steel Piping: Multiple-ply stainless-steel corrugated hose with stainless steel outer braid, and steel pipe end connections.
4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 450 deg F for copper piping connectors, 800 deg F for steel piping connectors.

E. Grooved Mechanical Flexible/Expansion Joint:

1. Manufacturers:
   a. Anvil International, Inc.; Fig. 7420 Expansion Joint.
   b. Victaulic Company; Model 77 Flexible Coupling, W77 AGS Flexible Coupling, and 177N QuickVic Installation-Ready Flexible Coupling.
2. Description: Comprised of multiple flexible style couplings, and precision machined grooved end pipe nipples. Assembly uses factory installed ties to custom preset expansion joint in the expanded, compressed, or intermediate position.
3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   a. Flexible Type: To provide a flexible pipe joint which allows for vibration isolation, expansion, contraction, and deflection. Quantity and arrangement as recommended by manufacturer.

2.03 EXPANSION JOINTS

A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.

f. Twin City Hose, Inc.

2. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections.
3. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple-ply stainless-steel bellows, and steel pipe end connections.
4. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 650 deg F.
6. Configuration: Single- or double -bellows type, unless otherwise indicated.
7. End Connections: Threaded, Flanged or weld.

B. Externally Pressurized Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with removable shipping bar.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.
2. Metal-Bellows Expansion Joints for Steel Piping: Multiple-ply or laminated stainless-steel bellows, steel pipe end connections, internal guide ring and stop, and carbon-steel shroud with drain plug.
3. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
4. Maximum Temperature Rating: 750 deg F.
5. Configuration: Single- or double -bellows type, unless otherwise indicated.
6. End Connections: Flanged or weld.

C. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, antitorque device, and removable end clip for positioning.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.
2. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
3. Configuration for Copper Piping: Two-ply stainless-steel bellows and bronze or stainless-steel shroud.
4. Configuration for Steel Piping: Two-ply stainless-steel bellows and carbon-steel shroud.
5. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint.

6. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint.
7. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
8. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or Weld.

D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.

1. Manufacturers:
   a. Flex-Hose Co., Inc.
   b. Metraflex, Inc.; Metraloop.
   c. Twin City Hose, Inc.
2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder- or brazed- joint end connections.
   a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with minimum 300 psig at 70 deg F and 230 psig at 400 deg F ratings.
   b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 230 psig at 70 deg F and 180 psig at 400 deg F ratings.
3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged or weld end connections to match piping system for NPS 2-1/2 and larger.
   a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 450 psig at 70 deg F and 325 psig at 600 deg F ratings; and 300 psig maximum saturated steam pressure rating.
   b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 165 psig at 70 deg F and 120 psig at 600 deg F ratings; and 130 psig maximum saturated steam pressure rating.
   c. NPS 8 to NPS 12: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 160 psig at 70 deg F and 115 psig at 600 deg F ratings; and 90 psig maximum saturated steam pressure rating.

E. Flexible Ball Joints: Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection, and 250 psig at 400 deg F minimum pressure rating; complying with ASME Boiler and Pressure Vessel Code: Section II, "Materials," and with ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.

1. Manufacturers:
   a. Advanced Thermal Systems, Inc.
   b. Hyspan Precision Products, Inc.; Barco.
2. Angular Deflection for NPS 6 and Smaller: 30-degree minimum.
3. Angular Deflection for NPS 8 and Larger: 15-degree minimum.
4. End Connections for NPS 2 and Smaller: Threaded.
5. End Connections for NPS 2-1/2 and Larger: Flanged.

2.04 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

1. Manufacturers:
    a. Adsco Manufacturing, LLC.
    b. Flex-Weld, Inc.
    c. Hyspan Precision Products, Inc.
    d. Metraflex, Inc.
    e. Senior Flexonics, Inc.; Pathway Division.

2.05 **SLIDING/GUIDING DEVICES**

A. For pipe size 4 inch and smaller on all hot piping, provide guides equal to Flexonics semi-steel spider and guiding cylinder pipe alignment guides for all expansion joints and loops. Provide pipe alignment guides in quantities at all locations as required according to the manufacturer's design criteria and recommendations. Pipe alignment guides shall serve to guide the expansion joints, loops or bends.
    1. Manufacturers:
        a. B-Line by Eaton; Figure 3281 Series.
        b. Senior Flexonics.
        c. Sypris Technologies; Tube Turns Division;
        d. U.S. Flexible Metallic Tubing Co., Kelflex Type M.
        e. Metraflex, Inc.

B. For pipe sizes 6 inches and above and all guides on cold piping, furnish pre-engineered pre-insulated guides with published vertical and lateral load ratings. Construction shall consist of an insulted shield containing structural calcium silicate (100 psi non-load bearing and 600 psi load bearing) encased in 360 degrees of overlapping sheet metal. A 36 steel clamps torqued onto insulated shield with recommended catalog torque valves. Slide service shall be stainless steel to polyethylene or Teflon with a maximum coefficient of friction of 0.15.
    1. Manufacturers:
        a. Pipe Shields, Inc. B3000, B4000, B7000 and B8000 series.
        b. Carpenter and Paterson, Inc.
        c. Rilco Mfg. HG 3000, HG 4000, HG 7000, and HG 8000 series.

2.06 **MATERIALS FOR ANCHORS**

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
    1. Stud: Threaded, zinc-coated carbon steel.
    2. Expansion Plug: Zinc-coated steel.
    3. Washer and Nut: Zinc-coated steel.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
    1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.

3. Washer and Nut: Zinc-coated steel.

F. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, 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

3.01 FLEXIBLE CONNECTOR APPLICATIONS

A. Use rubber flexible pipe connectors at the inlet and outlet water connections of base mounted pumps, chillers, and cooling towers, unless otherwise indicated.

1. Rubber Flexible Connectors for Pipe Sized NPS 2 and Smaller: Twin-sphere with female union end connections.

2. Rubber Flexible Connectors for Pipe Sized NPS 2-1/2 and Larger: Twin-sphere with floating flange end connections.

B. Flexible Pipe Connectors for Refrigerant Pipe: Refer to Division 23 Section “Refrigerant Piping.”

3.02 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Install expansion joints of sizes matching size of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

D. Install alignment guides at spacing recommended by expansion joint manufacturer.

E. Control expansion joint movement by installing two rigid pipe guides on each side of the expansion joint. Spacing shall be as follows:

Nom. Pipe Size	Exp. Joint to 1st Guide	1st to 2nd Guide	Maximum Distance Between Intermediate Guides (Ft.) For Tabulated pressures, PSIG							
(In.)			50	100	150	200	250	300	350	400
1	0'-4"	1'-4"	21	15	12					
1 1/4	0'-5"	1'-5"	23	17	13					
1 1/2	0'-6"	1'-9"	28	20	17					
2	0'-8"	2'-4"	32	23	18					
2 1/2	0'-10"	2'11"	35	28	22					
3	1'-0"	3'-6"	21	19	17	16	15	14	13	13
4	1'-4"	4'-8"	35	29	25	22	20	19	18	17
6	2'-0"	7'-0"	57	44	37	32	29	27	25	23
8	2'-8"	9'-4"	66	52	45	40	36	33	31	29
10	3'-4"	11'-8"	91	69	58	51	46	42	39	36
12	4'-0"	14'-0"	107	79	66	58	52	48	44	41
14	4'-8"	16'-4"	115	85	71	62	56	51	47	
16	5'-4"	18'-8"	127	94	78	68	61	56	52	
18	6'-0"	21'-0"	139	102	85	74	67	61	56	
20	6'-8"	23'-4"	151	110	91	80	71			

24	8'-0"	28'-0"	172	125	103	89	80
30	10'-0"	35'-0"	200	144	118	103	92

3.03 **PIPE BEND AND LOOP INSTALLATION**

A. Attach pipe bends and loops to anchors.

1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.04 **SWING CONNECTIONS**

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.05 **ALIGNMENT-GUIDE INSTALLATION**

A. Install guides on piping adjoining pipe expansion joints and bends and loops.

B. Attach guides to pipe and secure to building structure.

3.06 **ANCHOR INSTALLATION**

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION

SECTION 20 0519 - METERS AND GAGES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 2
1.05 CLOSEOUT SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS 2
2.03 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS 3
2.04 THERMOWELLS 3
2.05 PRESSURE GAGES 3
2.06 TEST PLUGS 4
2.07 FLOW MEASURING DEVICES 4
2.08 PITOT-TUBE FLOWMETERS 5
2.09 WAFER-ORIFICE FLOWMETERS 5
2.10 VENTURI FLOWMETERS 6
2.11 TURBINE FLOWMETERS 7
2.12 FLOW INDICATORS 7
2.13 MAGNETIC INDUCTIVE FLOWMETER 8
2.14 MAGNETIC INDUCTIVE FLOWMETER (INSERTION TYPE) 9
PART 3 EXECUTION 9
3.01 THERMOMETER APPLICATIONS 9
3.02 GAGE APPLICATIONS 10
3.03 INSTALLATIONS 10
3.04 CONNECTIONS 11
3.05 ADJUSTING 11

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 21 Section “Fire-Suppression Piping” for listed or approved pressure gages.
4. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
5. Division 23 Section "Fuel Gas Piping" for gas utility meters.

1.02 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FPR: Fiberglass reinforced plastic.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Schedule for the following indicating manufacturer's number, scale range, and location for each:

1. Thermometers.
2. Gages.
3. Flowmeters.
4. Thermal-energy meters.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For the following to include in operation and maintenance manuals:

1. Flowmeters.
2. Thermal-energy meters.

1.06 **QUALITY ASSURANCE**

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **METAL-CASE, LIQUID-IN-GLASS THERMOMETERS**

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Miljoco Corporation.
3. REOTEMP Instrument Corporation.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 **PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS**

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Marsh Bellofram.
3. Miljoco Corp.
4. REOTEMP Instrument Corporation.
5. Trerice, H. O. Co.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Plastic, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Metal, for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.04 **THERMOWELLS**

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F; ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.05 **PRESSURE GAGES**

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Cambridge.
3. Dwyer Instruments, Inc.
4. Marsh Bellofram.
5. Miljoco Corporation.
6. Trerice, H. O. Co.
7. Weiss Instruments, Inc.
8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.

4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanent scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic.
8. Ring: Stainless steel or chrome plated metal.

C. Accuracy: Grade A, plus or minus 1 percent of middle half scale.

1. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
2. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
3. Steam (15 psig and less): 30 inches Hg vacuum-30 PSIG (1 inch divisions below 0 psi; 1 psi divisions above 0 psi), silicone dampened.
4. Steam (16 to 60 psig): 30 inches Hg vacuum-100 PSIG, silicone dampened.
5. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

D. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass ball type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.06 TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Co., Inc.
2. Miljoco Corporation.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services, and 500 psig at 275 deg F for hot services.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be Nordel.

E. Test Kit: Furnish test kit(s) containing one pressure gage and adaptor, thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. Carrying case shall have formed instrument padding.

2.07 FLOW MEASURING DEVICES

A. Manufacturers:

1. Dietrich Standard Subsidiary of Rosemount Division of Emerson Process Management; Diamond II - Flo-Tap Model.

2. Preso Meters Corporation.

3. Taco, Inc.

B. Flow measuring device shall be used where indicated on the drawings and in sizes NPS 6 and larger and shall be annular primary flow elements. The annular primary flow elements shall be type 316, stainless steel, diamond shape or elliptical shape in cross-section. Pressure rating shall meet or exceed system minimum pressure rating as indicated for each system. Provide permanent, rust-proof metal identification tag on a chain indicating design flow rates, metered fluid and line size. Flow measuring devices shall be weld insert type. Units shall be capable of being inserted without system shut-down.

C. Accuracy shall be plus or minus 1 percent over a flow turndown at least 10 to 1, independent of Reynold's number. Repeatability shall be plus or minus 0.1 percent.

D. Sensors shall be installed in strict accordance with the manufacturer's recommendations with special attention given to alignment and straight run requirements.

E. Flow measuring device in chilled water system de-coupler pipe shall have bi-directional flow measurement capability, or two uni-directional devices shall be provided.

F. Flow gages which read in actual GPM shall be provided for all flow measuring devices on pumps 200 GPM or larger, and for both flow directions on the chilled water system de-coupler pipe flow measuring device. Gage scale shall be linear to flow. Maximum flow rate on scale shall be selected at 120 percent of the pump's scheduled flow rate (120 percent of the scheduled flow rate of one chiller for the chilled water system de-coupler). Gage scale shall be 2.5 inch x 6 inch minimum, or 4 inch diameter minimum, and shall be mounted at eye level on unistrut support.

2.08 PITOT-TUBE FLOWMETERS

A. Manufacturers:

1. Dieterich Standard; Subsidiary of Rosemount Division of Emerson Process Management.

2. Preso Meters Corporation.

3. Taco, Inc.

4. World Class Engineered Products, Inc.; PSE Division.

B. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute.

C. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.

D. Pressure Rating: 150 psig minimum.

E. Temperature Rating: 250 deg F minimum.

F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.

G. Integral Transformer: For low-voltage power connection.

H. Accuracy: Plus or minus 1 percent for liquids and gases.

2.09 WAFER-ORIFICE FLOWMETERS

A. Manufacturers:

1. ABB, Inc.; ABB Instrumentation.

2. Armstrong Pumps, Inc.

3. Badger Meter, Inc.; Industrial Div.

4. Bell & Gossett; Xylem Inc.

5. Meriam Instruments Div.; Scott Fetzer Co.

B. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.

C. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.

D. Pressure Rating: 300 psig.

E. Temperature Rating: 250 deg F.

F. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.

G. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

1. Scale: Gallons per minute.

2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.

H. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot hoses in carrying case.

1. Scale: Gallons per minute.

2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.

I. Operating Instructions: Include complete instructions with each flowmeter.

2.10 VENTURI FLOWMETERS

A. Manufacturers:

1. Armstrong Pumps, Inc.

2. Badger Meter, Inc.; Industrial Div.

3. Bailey-Fischer & Porter Co.

4. Flow Design, Inc.

5. Gerand Engineering Co.

6. Hyspan Precision Products, Inc.

7. Leeds & Northrup.

8. McCrometer, Inc.

9. Preso Meters Corporation.

10. Victaulic Co. of America.

B. Description: Differential-pressure design for installation in piping; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.

C. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data.

D. Pressure Rating: 250 psig.

E. Temperature Rating: 250 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged or welded.

H. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.

I. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

1. Scale: Gallons per minute.

2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.

J. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot hoses in carrying case.

1. Scale: Gallons per minute.

2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.

K. Operating Instructions: Include complete instructions with each flowmeter.

2.11 TURBINE FLOWMETERS

A. Manufacturers:

1. Badger Meter, Inc.; Industrial Div.
2. Bailey-Fischer & Porter Co.
3. Data Industrial Corp.
4. Engineering Measurements Company.
5. ERDCO Engineering Corp.
6. Fisher, George Inc.
7. Hoffer Flow Controls, Inc.
8. ISTEC Corporation.
9. Midwest Instruments & Controls Corp.
10. ONICON Incorporated.
11. SeaMetrics Inc.
12. Sponsler Company, Inc.
13. Thermo Measurement Ltd.
14. Venture Measurement.

B. Description: Insertion type for inserting turbine into piping and measuring flow directly in gallons per minute.

C. Construction: Bronze or stainless-steel body; with plastic turbine or impeller and integral direct-reading scale.

D. Pressure Rating: 150 psig minimum.

E. Temperature Rating: 180 deg F minimum.

F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.

G. Accuracy: Plus or minus 2-1/2 percent.

2.12 FLOW INDICATORS

A. Manufacturers:

1. Brooks Instrument Div.; Emerson Electric Co.
2. Clark-Reliance Corporation; Jacoby-Tarbox.

3. Dwyer Instruments, Inc.
4. McCrometer, Inc.
5. OPW Engineered Systems; Dover Corp.
6. Penberthy, Inc.

B. Description: Instrument for installation in piping systems for visual verification of flow.

C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.

D. Pressure Rating: 125 psig.

E. Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.13 MAGNETIC INDUCTIVE FLOWMETER

A. Manufacturers:

1. Badger Meter, Inc.; Magnetoflow with Primo Amplifier.
2. Emerson Process Management; Rosemount Division.

B. Description: Magnetic inductive flowmeter and amplifier for measuring the flow of conductive liquids, with flanged ends, suitable for in-line installation.

C. Accuracy: 0.25 percent of rate at 1 to 39 fps.

D. Pressure Limits: 150 psi.

E. Ambient Temperature Limits: Minus 4 deg F to 140 deg F.

F. Liner Material:

1. Meter Sizes NPS 1/4 to NPS 3/8: PFA.
2. Meter Sizes NPS 1/2 to NPS 24: PTFE.
3. Meter Sizes NPS 1 to NPS 54: Soft and hard rubber.
4. Meter Sizes NPS 14 to NPS 36: Halar.
5. NSF Listed Meters Sizes NPS 4 and Larger: Hard Rubber.

G. Measured Fluid Temperature Limits:

1. Remote Amplifier:
   a. PFA, PTFE, and Halar Liners:311 deg F.
   b. Rubber Liner: 178 deg F.
2. Meter Mounted Amplifier:
   a. PFA, PTFE, and Halar Liners: 212 deg F.
   b. Rubber Liner: 178 deg F.

H. Flowmeter:

1. Meter Housing Material: Carbon steel, welded.
2. Flanges: Carbon steel, ANSI B16.5 Class 150 raised face.
3. Pipe Spool Material: Type 316 stainless steel.
4. Electrode Material: Type 316 stainless steel.

I. Meter Enclosure Classification: NEMA 4.

J. Junction Box Enclosure: Die-cast aluminum with powder coat finish. NEMA 4.

K. Amplifier: Microprocessor based with back-lit LCD display in cast aluminum, powder coated NEMA 4X enclosure suitable for either remote wall mounting or mounting on meter, and with:

1. Digital and analog outputs.
2. Bidirectional flow sensing/totalization.
3. Automatic zero point stability.
4. Empty pipe detection.
5. RS232 serial communication.
6. 115 VAC, 60 Hz power supply.

2.14 **MAGNETIC INDUCTIVE FLOWMETER (INSERTION TYPE)**

A. Manufacturers:

1. KOBOLD Instruments Inc.; Model PME-12R40.
2. KROHNE Inc.

B. Description: Magnetic inductive flowmeter for measuring the flow of conductive liquids in pipes and suitable for installation in pipes size NPS 1-1/2 to NPS 12.

C. Input Power: 24 VDC, 2.5 watts.

D. Current Output: 4-20mA, active bi-directional measurement, output always positive.

E. Temperature Ratings:

1. Ambient Temperature: 140 deg F maximum.
2. Measured Fluid Temperature: 0 to 212 deg F.

F. Pressure Rating: 230 psig at 75 deg F.

G. Transmitter Span: 1-5 meters/second (adjustable).

H. Accuracy: Plus or minus 2 percent of velocity at the measuring electrode.

I. Repeatability: Plus or minus 2 percent of measured value.

J. Noise Immunity: CE per EN 50081-1-2 and EN 50082-1-2.

K. Electrical Protection (Enclosure) Type: NEMA 4X/IP 65.

L. Wetted Parts:

1. Sensor Tip: PVDF with Viton O-ring.
2. Electrodes: Type 316 L stainless steel.
3. Flow Transmitter: Provided with Type 316L stainless steel weld sleeve.
4. Sealing Ring: Buna-N.

M. Case: Aluminum, epoxy powder coated.

PART 3 EXECUTION

3.01 **THERMOMETER APPLICATIONS**

A. Install liquid-in-glass thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler and chiller.

3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
4. Inlet and outlet of each hydronic heat exchanger.
5. Inlet and outlet of each hydronic heat-recovery unit.
6. Inlet and outlet of each thermal storage tank.
7. Outside-air, return-air, and mixed-air ducts.

B. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.
3. Heat Pump Loop Water: 30 to 240 deg F, with 2-degree scale divisions.

3.02 **GAGE APPLICATIONS**

A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.03 **INSTALLATIONS**

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

D. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).

E. Install ball valve and syphon fitting in piping for each pressure gage for steam.

F. Install test plugs in tees in piping.

G. Install flow indicators, in accessible positions for easy viewing, in piping systems.

H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

I. Install flowmeter elements in accessible positions in piping systems.

J. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

K. Install wafer-orifice flowmeter elements between pipe flanges.

L. Install permanent indicators on walls or brackets in accessible and readable positions.

M. Install connection fittings for attachment to portable indicators in accessible locations.

N. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.

O. Assemble components and install thermal-energy meters.

P. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.04 **CONNECTIONS**

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy-meter transmitters to meters.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **ADJUSTING**

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION

SECTION 20 0529 - HANGERS AND SUPPORTS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 PERFORMANCE REQUIREMENTS 2
1.04 ACTION SUBMITTALS 2
1.05 INFORMATIONAL SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 HANGER ROD MATERIAL 2
2.03 STEEL PIPE HANGERS AND SUPPORTS 2
2.04 TRAPEZE PIPE HANGERS 3
2.05 METAL FRAMING SYSTEMS 3
2.06 METAL INSULATION SHIELDS 3
2.07 PIPE COVERING PROTECTION SADDLES 3
2.08 PLASTIC INSULATION SHIELDS 4
2.09 THERMAL-HANGER SHIELDS 4
2.10 FASTENER SYSTEMS 5
2.11 ROOF MOUNTED PIPING SUPPORTS 5
2.12 ROOF MOUNTED EQUIPMENT SUPPORTS 8
2.13 EQUIPMENT SUPPORTS 9
2.14 MISCELLANEOUS MATERIALS 9
PART 3 EXECUTION 9
3.01 HANGER AND SUPPORT APPLICATIONS 9
3.02 HANGER AND SUPPORT INSTALLATION 11
3.03 EQUIPMENT SUPPORTS 14
3.04 METAL FABRICATIONS 14
3.05 ADJUSTING 14
3.06 PAINTING 14

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
5. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops" for pipe guides and anchors.
6. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.
7. Division 23 Section(s) "Metal Ducts" for duct hangers and support.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. MFMA: Metal Framing Manufacturers Association.

1.03 **PERFORMANCE REQUIREMENTS**

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 **ACTION SUBMITTALS**

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

1.05 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

1.06 **QUALITY ASSURANCE**

A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:

1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **HANGER ROD MATERIAL**

A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.

1. Rod continuously threaded.
2. Use of rod couplings is prohibited.

2.03 **STEEL PIPE HANGERS AND SUPPORTS**

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.

1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.

B. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. Hilti USA.

5. nVent Electric plc; CADDY.
6. PHD Manufacturing, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.04 **TRAPEZE PIPE HANGERS**

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.05 **METAL FRAMING SYSTEMS**

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. Anvil; Anvil-Strut; ASC Engineered Solutions.
2. B-Line by Eaton.
3. nVent Electrical plc; ERISTRUT Div.
4. Power-Strut; a part of Atkore International.
5. Unistrut; a part of Atkore International.
6. Hilti USA.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.06 **METAL INSULATION SHIELDS**

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.

C. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.07 **PIPE COVERING PROTECTION SADDLES**

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.

1. Saddles shall match insulation thickness.
2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.08 **PLASTIC INSULATION SHIELDS**

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. Armacell LLC; Insuguard.
3. B-Line by Eaton; Snap'N Shield.
4. Hydra-Zorb Company; Bronco.

B. Description: Polypropylene copolymer protective shields with modular elements designed to snap directly onto strut channel, clevis hangers, or structural members. Shields shall span an arc of 180 degrees.

1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F.

C. Certifications:

1. UL Classified for USA: UL-723 (ASTM E 84).
2. UL listed for Canada: ULC-S102.2.
3. Meets UL94 HB flammability standards.

D. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 4: 12 inches long.

2.09 **THERMAL-HANGER SHIELDS**

A. Manufacturers:

1. American Mechanical Insulation Sales Inc. (AMIS).
2. B-Line by Eaton.
3. nVent Electric plc; CADDY.
4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.

1. Minimum Compressive Strength of Insert Material:
   a. 100-psig- for sizes smaller than NPS 6.
   b. 600-psig- for sizes NPS 6 and larger.

C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.

G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:

1. Manufacturer:

a. B-Line by Eaton/Armacell; Armafix IPH.

b. Aeroflex USA, Inc.; Aerofix-U.

c. ZSi-Foster, Inc.; Cush-A-Therm.

2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:

a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.

H. Thermal-Hanger Shields for Small Diameter Piping:

1. Manufacturer:

a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.

2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:

a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.10 FASTENER SYSTEMS

A. Post-Installed Anchors:

1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

a. Manufacturers:

1) B-Line by Eaton.

2) DeWalt Engineered by Powers.

3) Hilti, Inc.

4) ITW Ramset/Red Head.

5) MKT Fastening, LLC.

2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.

a. UL Listed or FMG approved for fire sprinkler piping.

b. Available Sizes: For 1/4-inch, 3/8-inch, and 1/2-inch diameter rod sizes

c. Manufacturers:

1) B-Line by Eaton; Rapid Rod Hangers.

2) DeWalt Engineered by Powers; Snake+.

2.11 ROOF MOUNTED PIPING SUPPORTS

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:
    a. B-Line by Eaton; Dura-Blok.
    b. Eco Support Products.
    c. MIFAB, Inc.; C-Port.
    d. MIRO Industries; Conduit and Condensate Supports, and Rooftop Sleeper Support.
    e. nVent Electric plc; CADDY.
    f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.

C. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:
    a. B-Line by Eaton; Dura-Blok.
    b. Eco Support Products.
    c. MIFAB, Inc.; C-Port.
    d. MIRO Industries; Conduit and Condensate Supports.
    e. nVent Electric plc; CADDY.
    f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

D. High, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and clevis type pipe support, for roof installation without membrane penetration.

1. Manufacturers:
    a. B-Line by Eaton; Dura-Blok.
    b. Eco Support Products.
    c. MIFAB, Inc.; C-Port.
    d. MIRO Industries; Water and Steam Supports.
    e. nVent Electric plc; CADDY.
    f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.

4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

E. Low, Fixed-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. MIFAB, Inc.; C-Port.
   d. MIRO Industries; Gas and Mechanical Supports.
   e. nVent Electric plc; CADDY.
   f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.

F. Low, Adjustable-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. MIFAB, Inc.; C-Port.
   d. MIRO Industries; Gas and Mechanical Supports.
   e. nVent Electric plc; CADDY.
   f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

G. High, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturer:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. MIFAB, Inc.; C-Port.
   d. MIRO Industries; Water and Steam Supports.
   e. nVent Electric plc; CADDY.
   f. Portable Pipe Hangers.
2. Bases: Two or more plastic, steel, or recycled rubber.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.

5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

H. Custom, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports or rollers, for roof installation without membrane penetration.

1. Manufacturer:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. MIFAB, Inc.; C-Port.
   d. MIRO Industries; Custom Design Products.
   e. nVent Electric plc; CADDY.
   f. Portable Pipe Hangers.
2. Bases: Four or more plastic, steel, or recycled rubber.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
6. Pipe Rollers: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.

I. Curb-Mounting Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

1. Roof Curb Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
   a. Manufacturers:
      1) Pate.
      2) Thybar; Thycurb.
      3) Roof Products and Systems.
      4) Greenheck.
      5) Creative Metals.

2.12 ROOF MOUNTED EQUIPMENT SUPPORTS

A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.

B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. MIFAB, Inc.; C-Port.
   d. MIRO Industries; HD and LD Mechanical Unit Supports.
   e. nVent Electric plc; CADDY.
   f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.

3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rood, and accessories.

C. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.

1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.

a. Manufacturers:

1) Pate.

2) Thybar; TEMS Series.

3) Roof Products and Systems.

4) Greenheck.

5) Creative Metals.

2.13 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.14 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Refer to application schedules on the Drawings.

B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.

C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

D. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.

E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.

F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.

G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.

H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

I. Use padded hangers for piping that is subject to scratching.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. MSS Type 8 or spring type to meet system requirements.

K. 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.

L. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
3. Use mechanical-expansion anchors where required in concrete construction.
4. Use chemical fasteners where required in concrete construction.

M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Beam Clamps:
   a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
   b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.

N. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer’s instructions to maintain listing.
2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer’s instructions to maintain listing.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:
   a. Provide spring supports at point of support where vertical movement will occur.
   b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.

c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.

d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.

e. Sway braces; TYPE 50.

f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.

P. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.02 **HANGER AND SUPPORT INSTALLATION**

A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.

B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.

C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.

D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.

E. File and paint cut ends and shop or field prime paint supporting element components.

F. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.

G. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.

H. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.

I. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.

J. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.

K. Where necessary, brace piping and supports against reaction, sway and vibration.

L. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.

M. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.

N. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.

O. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.

P. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.

Q. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.

R. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.

S. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.

T. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.

U. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.

V. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.

W. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.

X. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.

Y. Building structure shall not be reinforced except as approved by the Architect in writing.

Z. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.

AA. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.

BB. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.

CC. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.

DD. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.

EE. 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 above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

FF. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

GG. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

HH. Roof-Mounting Pipe and Equipment Stand Installation:

1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.

3. Maintain support manufacturer’s recommended spacing.

II. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

JJ. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

KK. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

LL. Install lateral bracing with pipe hangers and supports to prevent swaying.

MM. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

NN. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

OO. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

PP. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.03 **EQUIPMENT SUPPORTS**

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 **METAL FABRICATIONS**

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 **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.

3.06 **PAINTING**

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 20 0547 - MECHANICAL VIBRATION CONTROLS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
1.03 COORDINATION 1
PART 2 PRODUCTS 1
2.01 VIBRATION ISOLATION EQUIPMENT BASES 1
2.02 VIBRATION ISOLATORS 4
2.03 VIBRATION ISOLATION HANGERS 7
2.04 FACTORY FINISHES 8
PART 3 EXECUTION 8
3.01 EXAMINATION 8
3.02 INSTALLATION 9
3.03 APPLICATION 9
3.04 CONNECTIONS 9
3.05 EQUIPMENT BASES 9
3.06 FIELD QUALITY CONTROL 9
3.07 ADJUSTING 9
3.08 CLEANING 10

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

1.03 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION EQUIPMENT BASES

A. **Type A**: Direct Isolator Attachment

1. Unit to be isolated is so constructed that vibration isolators of the type specified may be directly attached, provided that the edge deflection of the isolated unit base over unsupported span between mountings does not exceed specified or manufacturer's limits. If units to be isolated will not meet required deflection provisions, Type B bases shall be provided.

B. **Type B**: Factory-fabricated, welded, structural-steel bases or rails.

1. Structural Steel Bases:

a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WF or a comparable product by one of the following:
   1) Amber/Booth; a VMC Group Company.
   2) Kinetics Noise Control, Inc.
   3) Korfund Dynamics; a VMC Group Company.
   4) Vibration Eliminator Co., Inc.
   5) Vibration Isolation Co., Inc. (Pump Bases Only)
   6) Vibration Mountings & Controls; a VMC Group Company.
   7) Vibro-Acoustics.

b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2. Structural-Steel Rails:

a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ICS or a comparable product by one of the following:
   1) Amber/Booth; a VMC Group Company.
   2) Kinetics Noise Control, Inc.
   3) Korfund Dynamics; a VMC Group Company.
   4) Vibration Eliminator Co., Inc.
   5) Vibration Isolation Co., Inc. (Pump Bases Only)
   6) Vibration Mountings & Controls; a VMC Group Company.
   7) Vibro-Acoustics.

b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. **Type C** Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type BMK/KSL or a comparable product by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Isolation Co., Inc. (Pump Bases Only)

f. Vibration Mountings & Controls; a VMC Group Company.

g. Vibro-Acoustics.

2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

4. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

D. **Type D** Curb Mounted Aluminum Bases:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type CMAB or a comparable product by one of the following:

a. Kinetics Noise Control, Inc.

b. ThyCurb/Thybar.

c. Vibro-Acoustics.

d. Vib-Iso.

2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.

3. Upper Frame: Corrosion resistant extruded aluminum. Upper frame shall overlap lower frame for water runoff. Mitered ends heliarc welded to prevent water leakage through corners.

4. Lower Frame: Corrosion resistant extruded aluminum. Lower framed shall overlap roof curb for water runoff. Mitered ends heliarc welded to prevent water leakage through corners.

5. Safety Stops: Neoprene, mounted in corners of lower frame for extreme wind conditions and mild seismic disturbances under normal conditions.

6. Isolators: Cadmium plated free-standing springs with positive spring retainer and flexible ties.

7. Splicing Kit: Required for bases shipped in multiple pieces.

8. Weatherseal: Flexible frictionless EPDM.

9. Static Deflection: Nominal 1 inch.

E. **Type E** Rooftop Spring Curb:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type RSC or a comparable product by one of the following:

a. Kinetics Noise Control, Inc.

b. ThyCurb/Thybar.

c. Vibro-Acoustics.

2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment; and to withstand wind forces as required by local codes.

3. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
4. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
    a. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with restraint.
        1) Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
        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 the rated vertical stiffness.
        5) Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
    b. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
        1) Material: Bridge-bearing neoprene, complying with AASHTO M 251.
        2) Durometer Rating: 40.
5. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
6. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
7. Sound Isolation: Within perimeter of roof curb rails and as detailed on the Drawings:
    a. Two layers of 2-inch thick board insulation, minimum 3-lb/cu. ft. density, glass fibers bonded with a thermosetting resin. Comply with ASTM C 612 Type IA or Type IB.
    b. Two layers of 5/8-inch thick water-resistant gypsum core wall panel surfaced with paper on front, back, and long edges. Comply with ASTM C 1396.
    c. One layer of 6-inch thick fiberglass blanket insulation.
8. Static Deflection: Nominal 1 inch, 2 inches, or 3 inches.

2.02 **VIBRATION ISOLATORS**

A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
    a. Amber/Booth; a VMC Group Company.
    b. Kinetics Noise Control, Inc.
    c. Korfund Dynamics; a VMC Group Company.
    d. Vibration Eliminator Co., Inc.
    e. Vibration Mountings & Controls; a VMC Group Company.
    f. Vibro-Acoustics.
2. Material: Standard neoprene for indoor applications.
3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:
    a. Amber/Booth; a VMC Group Company.
    b. Kinetics Noise Control, Inc.
    c. Korfund Dynamics; a VMC Group Company.
    d. Vibration Eliminator Co., Inc.
    e. Vibration Mountings & Controls; a VMC Group Company.
    f. Vibro-Acoustics.
2. Material: Standard neoprene for indoor applications.
3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

C. **Type 2** Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ND or a comparable product by one of the following:
    a. Amber/Booth; a VMC Group Company.
    b. Kinetics Noise Control, Inc.
    c. Korfund Dynamics; a VMC Group Company.
    d. Vibration Eliminator Co., Inc.
    e. Vibration Mountings & Controls; a VMC Group Company.
    f. Vibro-Acoustics.
2. Durometer Rating: Selected for maximum possible static deflection with the loading of each piece of equipment.

3. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
4. Neoprene: Bridge-bearing neoprene as defined by AASHTO.

D. **Type 3** Spring Isolators: Freestanding, open-spring isolators.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type SLF or a comparable product by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.
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. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. **Type 4** Restrained Spring Isolators: Restrained single and multiple spring mounts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Types SLR and SLRS or comparable products by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.
2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. **Type 5** Thrust Restraints

1. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression or tension as required, and with a load stop. Include rod and angle-iron brackets with back-up plates for attaching to equipment and ductwork.
    a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WBI for fan inlet connections, and Type WBD for fan outlet connections, or comparable products by one of the following:
        1) Amber/Booth; a VMC Group Company.
        2) Kinetics Noise Control, Inc.
        3) Korfund Dynamics; a VMC Group Company.
        4) Vibration Eliminator Co., Inc.
        5) Vibration Mountings & Controls; a VMC Group Company.
        6) Vibro-Acoustics.
    b. 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.
    c. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    d. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    e. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
    f. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
    g. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
    h. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.03 **VIBRATION ISOLATION HANGERS**

A. **Type 8a** Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
    1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type 30N or a comparable product by one of the following:
        a. Amber/Booth; a VMC Group Company.
        b. Kinetics Noise Control, Inc.
        c. Korfund Dynamics; a VMC Group Company.
        d. Vibration Eliminator Co., Inc.
        e. Vibration Mountings & Controls; a VMC Group Company.
        f. Vibro-Acoustics.
    2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
    3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

B. **Type 8b** Spring Hangers with Vertical-Limit Stop: Precompressed combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type PC30N or a comparable product by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

2.04 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."

B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

3.03 **APPLICATION**

A. Refer to Vibration Isolator Application Schedule on the drawings for isolator application and minimum deflection.

3.04 **CONNECTIONS**

A. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.

B. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.05 **EQUIPMENT BASES**

A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.

1. Cast-in-place concrete materials and placement requirements are specified in Division 03.

B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.06 **FIELD QUALITY CONTROL**

A. Testing: Perform the following field quality-control testing:

1. Isolator deflection.

2. Snubber minimum clearances.

3.07 **ADJUSTING**

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

D. Adjust active height of spring isolators.

E. Adjust snubbers according to manufacturer's written recommendations.

3.08 **CLEANING**

A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION

SECTION 20 0553 - MECHANICAL IDENTIFICATION

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
1.03 INFORMATIONAL SUBMITTALS 1
1.04 CLOSEOUT SUBMITTALS 1
1.05 QUALITY ASSURANCE 2
1.06 COORDINATION 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 EQUIPMENT IDENTIFICATION DEVICES 2
2.03 PIPING IDENTIFICATION DEVICES 3
2.04 DUCT IDENTIFICATION DEVICES 3
2.05 HAZARDOUS MATERIAL IDENTIFICATION DEVICES 3
2.06 VALVE TAGS 4
2.07 VALVE SCHEDULES 4
2.08 WARNING TAGS 4
PART 3 EXECUTION 4
3.01 APPLICATIONS, GENERAL 4
3.02 EQUIPMENT IDENTIFICATION 4
3.03 PIPING IDENTIFICATION 6
3.04 DUCT IDENTIFICATION 6
3.05 VALVE-TAG INSTALLATION 7
3.06 VALVE-SCHEDULE INSTALLATION 7
3.07 HAZARDOUS MATERIAL IDENTIFICATION DEVICES 7
3.08 WARNING-TAG INSTALLATION 7
3.09 ADJUSTING 7
3.10 CLEANING 7
3.11 SCHEDULES 7

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Samples: For color, letter style, and graphic representation required for each identification material and device.

B. Valve numbering scheme.

1.04 CLOSEOUT SUBMITTALS

A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.05 **QUALITY ASSURANCE**

A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.06 **COORDINATION**

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Seton.
2. Brady.
3. EMED.
4. Craftmark.
5. Brimar Industries, Inc.
6. Marking Services Inc. (MSI).
7. Kolbi Pipe Marker Co.

2.02 **EQUIPMENT IDENTIFICATION DEVICES**

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
    a. Manufacturer, product name, model number, and serial number.
    b. Capacity, operating and power characteristics, and essential data.
    c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:
    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.03 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
3. Legends: Spelled out in full or commonly used and accepted abbreviations.
4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

F. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.

G. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.04 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.05 HAZARDOUS MATERIAL IDENTIFICATION DEVICES

A. Standard: NFPA 704.

B. Material: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive; or mounting screws.

C. Size: Minimum 7-1/2 inches by 7-1/2 inches with 3-inch character height.

D. Content: Appropriate for refrigerant.

2.06 **VALVE TAGS**

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect/Engineer. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick brass.

2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.07 **VALVE SCHEDULES**

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.

2. Frame: Finished hardwood or extruded aluminum.

3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.08 **WARNING TAGS**

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.

2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 **APPLICATIONS, GENERAL**

A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 **EQUIPMENT IDENTIFICATION**

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.

2. Pumps, compressors, chillers, condensers, and similar motor-driven units.

3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.

4. Fans, blowers, primary balancing dampers, and mixing boxes.

5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

b. Fire department hose valves and hose stations.

c. Meters, gages, thermometers, and similar units.

d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.

e. Pumps, compressors, chillers, condensers, and similar motor-driven units.

f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.

g. Fans, blowers, primary balancing dampers, and mixing boxes.

h. Packaged HVAC central-station and zone-type units.

i. Tanks and pressure vessels.

j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:

a. Green: For cooling equipment and components.

b. Yellow: For heating equipment and components.

c. Orange: For combination cooling and heating equipment and components.

d. Brown: For energy-reclamation equipment and components.

2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

4. Include signs for the following general categories of equipment:

a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.

c. Pumps, compressors, chillers, condensers, and similar motor-driven units.

d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.

e. Fans, blowers, primary balancing dampers, and mixing boxes.

f. Packaged HVAC central-station and zone-type units.

g. Tanks and pressure vessels.

h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. Install access panel markers with screws on equipment access panels.

E. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.

2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.04 DUCT IDENTIFICATION

A. Install engraved duct markers with permanent adhesive on air ducts in the following color codes:

1. Refer to Schedule.

2. ASME (ANSI) A13.1 Colors and Designs: For hazardous material exhaust.

3. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Identify ductwork with vinyl markers and flow direction arrows.

C. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 **VALVE-TAG INSTALLATION**

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

a. Cold Water: Minimum 1-1/2 inches, round or square.

b. Hot Water: Minimum 1-1/2 inches, round or square.

c. Fire Protection: Minimum 1-1/2 inches, round or square.

d. Gas: Minimum 1-1/2 inches, round or square.

3.06 **VALVE-SCHEDULE INSTALLATION**

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.07 **HAZARDOUS MATERIAL IDENTIFICATION DEVICES**

A. Mount to wall or door of room containing hazard. Indicate classification of refrigerant or other hazard.

3.08 **WARNING-TAG INSTALLATION**

A. Write required message on, and attach warning tags to equipment and other items where required.

3.09 **ADJUSTING**

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 **CLEANING**

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.11 **SCHEDULES**

A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

Pipe System Label	Drawing Abbrev.	Labels	Piping
Sanitary Sewer	SAN	White on Green	Dark Brown
Sanitary Vent	V	White on Green	Dark Brown
Rain Conductor	RC	White on Green	Dark Brown
Acid Waste	AW	Black on Yellow	Black
Acid Vent	AV	Black on Yellow	Black
Domestic Cold Water	CW	White on Green	Light Green
High Pressure Domestic Cold Water	HPCW	White on Green	Light Green
Non-Potable Cold Water	NPCW	Black on Yellow	
Domestic Hot Water	HW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water	HPHW	Black on Yellow	Dark Green

Pipe System Label	Drawing Abbrev.	Labels	Piping
High Pressure Domestic Hot Water Return	HPHWR	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Soft Cold Water	SCW	White on Green	Light Green
Soft Hot Water	SHW	White on Green	Dark Green
Soft Hot Water Return	SHWR	White on Green	Dark Green
Natural Gas	G	Black on Yellow	Yellow
Fuel Oil Supply	FOS	Black on Yellow	Yellow
Fuel Oil Return	FOR	Black on Yellow	Yellow
Compressed Air (90psig)	A(90psig)	Black on Yellow	Dark Blue
Compressed Air (25psig)	A	White on Green	Dark Blue
Laboratory Vacuum	LVAC	Black on Yellow	Unpainted
Carbon Dioxide	CO_2	Black on Yellow	Unpainted
High Purity Water	DI	White on Green	White
Hot Water Htg. Supply	HWHS	Black on Yellow	Dark Blue
Hot Water Htg. Return	HWHR	Black on Yellow	Dark Blue
Terminal Unit Heating Sup.	THS	Black on Yellow	Dark Blue
Terminal Unit Heating Ret.	THR	Black on Yellow	Dark Blue
Animal Heating Supply	AHS	Black on Yellow	Dark Blue
Animal Heating Return	AHR	Black on Yellow	Dark Blue
Energy Recovery Loop Sup.	ERLS	Black on Yellow	Dark Blue
Energy Recovery Loop Ret.	ERLR	Black on Yellow	Dark Blue
Chilled Water Supply	CHWS	White on Green	Light Blue
Chilled Water Return	CHWR	White on Green	Light Blue
Condenser Water Supply	CWS	White on Green	Light Green
Condenser Water Return	CWR	White on Green	Light Green
Process Cooling Water Sup.	PCWS	White on Green	Light Green
Process Cooling Water Ret.	PCWR	White on Green	Light Green
Refrigerant Liquid	RL	Black on Yellow	
Refrigerant Suction	RS	Black on Yellow	
Steam Condensate	LPC	Black on Yellow	Aluminum
Medium Pressure Steam Condensate	MPC	Black on Yellow	Aluminum
High Pressure Steam Condensate	HPC	Black on Yellow	Aluminum
Pumped Steam Condensate	PC	Black on Yellow	Aluminum
Medium Pressure Steam (60 psig)	MPS	Black on Yellow	Aluminum
High Pressure Steam,	HPS	Black on Yellow	Aluminum
Low Pressure Steam (5 psig)	LPS	Black on Yellow	Aluminum
Fire Protection	FP	White on Red	Bright Red
Medical Gases	Refer to Division 22 Section “Medical Gas Systems.”		

SHEET METAL WORK

Service	Abbrev.	Labels	Ductwork
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White
Mixed Air	Mixed Air	White on Green	White

END OF SECTION

SECTION 20 0700 - MECHANICAL INSULATION

PART 1 GENERAL 2
1.01 RELATED DOCUMENTS 2
1.02 SUMMARY 2
1.03 DEFINITIONS 2
1.04 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION 2
1.05 OUTDOOR, ABOVEGROUND PIPING INSULATION SYSTEMS DESCRIPTION 2
1.06 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION 2
1.07 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION 2
1.08 EQUIPMENT INSULATION SYSTEMS DESCRIPTION 3
1.09 FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION 3
1.10 ACTION SUBMITTALS 3
1.11 QUALITY ASSURANCE 3
1.12 DELIVERY, STORAGE, AND HANDLING 3
1.13 COORDINATION 3
1.14 SCHEDULING 3

PART 2 PRODUCTS 4
2.01 INSULATION MATERIALS, GENERAL REQUIREMENTS 4
2.02 PIPE INSULATION MATERIALS 4
2.03 DUCTWORK INSULATION MATERIALS 4
2.04 EQUIPMENT INSULATION MATERIALS 5
2.05 FIRE-RATED INSULATION SYSTEMS 6
2.06 INSULATING CEMENTS 6
2.07 ADHESIVES 6
2.08 MASTICS 7
2.09 SEALANTS 8
2.10 FACTORY-APPLIED JACKETS 8
2.11 FIELD-APPLIED FABRIC-REINFORCING MESH 8
2.12 FIELD-APPLIED CLOTHS 9
2.13 FIELD-APPLIED JACKETS 9
2.14 REMOVABLE AND REUSABLE INSULATION COVERS 11
2.15 REMOVABLE AND REUSABLE ACOUSTIC INSULATION COVERS 11
2.16 TAPES 12
2.17 SECUREMENTS 13
2.18 CORNER ANGLES 15

PART 3 EXECUTION 15
3.01 EXAMINATION 15
3.02 PREPARATION 16
3.03 COMMON INSTALLATION REQUIREMENTS 16
3.04 PENETRATIONS 17
3.05 GENERAL PIPE INSULATION INSTALLATION 18
3.06 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION 19
3.07 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION 20
3.08 DUCT AND PLENUM INSULATION INSTALLATION 21
3.09 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION 23
3.10 FIELD-APPLIED JACKET INSTALLATION 24
3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION 24
3.12 FINISHES 24

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section “Hanger and Supports” for thermal hanger shield inserts.
4. Division 22 Section “Plumbing Fixtures: for protective shielding guards.
5. Division 23 Section "Metal Ducts" for duct liners.

1.02 SUMMARY

A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.03 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. PSK: Polypropylene, scrim, kraft paper.

D. PVC: Polyvinyl Chloride.

E. SSL: Self-sealing lap.

1.04 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

B. Sanitary Waste Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 1-1/2 inches thick.

C. Hot Service Drains, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.

D. Hot Service Vents, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.

1.05 OUTDOOR, ABOVEGROUND PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

B. Sanitary or Storm Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 2 inches thick.

C. Hot Service Drains, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 1 inch thick.

D. Hot Service Vents, All Pipe Sizes: Mineral Wool Pipe Insulation, Type II: 1 inch thick.

1.06 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.07 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

A. Acceptable outdoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.08 **EQUIPMENT INSULATION SYSTEMS DESCRIPTION**

A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.09 **FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION**

A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe specialty.

B. Steam Condensate Piping within Air Handling Units: Aluminum, Stucco Embossed: 0.016 inch thick.

C. Piping Within Energy Recovery Units: Type 304 Stainless Steel, Smooth: 0.010 inch thick. Seams and joints calked with chemically resistant sealer.

D. Steam Pressure Reducing Valves: Sound Barrier Jacketing: Smooth or stucco embossed.

1.10 **ACTION SUBMITTALS**

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1. ESR Report: For fire-rated grease duct insulation.

1.11 **QUALITY ASSURANCE**

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.12 **DELIVERY, STORAGE, AND HANDLING**

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer’s original packaging.

1.13 **COORDINATION**

A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.14 **SCHEDULING**

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS, GENERAL REQUIREMENTS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.02 PIPE INSULATION MATERIALS

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
    b. Armacell LLC; AP Armaflex.
    c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.

B. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Johns Manville; Micro-Lok.
    b. Knauf Insulation; 1000 Pipe Insulation.
    c. Manson Insulation Inc.; Alley-K.
    d. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

C. Mineral-Wool, Preformed Pipe Insulation, Type II:

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Johns Manville.
    b. Owens Corning/Thermafiber.
    c. Rock Wool Manufacturing Company; Delta PC and PF.
2. Type II, 1200 deg F Materials: Mineral wool fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied, or field-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article. Field-applied jacket requirements are specified in Part 2 "Field-Applied Jackets" Article.

2.03 DUCTWORK INSULATION MATERIALS

A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.Products: Subject to compliance with requirements, provide one of the products specified.
    a. CertainTeed Corp.; Duct Wrap.

b. Johns Manville; Microlite EQ.

c. Knauf Insulation; Duct Wrap.

d. Manson Insulation Inc.; Alley Wrap B.

e. Owens Corning; All-Service Duct Wrap.

B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. CertainTeed Corp.; Commercial Board.

b. Fibrex Insulations Inc.; FBX.

c. Johns Manville; 800 Series Spin-Glas.

d. Knauf Insulation; Insulation Board.

e. Manson Insulation Inc.; AK Board.

f. Owens Corning; Fiberglas 700 Series.

2.04 EQUIPMENT INSULATION MATERIALS

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.

b. Armacell LLC; AP Armaflex.

c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.

B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. CertainTeed Corp.; Commercial Board.

b. Fibrex Insulations Inc.; FBX.

c. Johns Manville; 800 Series Spin-Glas.

d. Knauf Insulation; Insulation Board.

e. Manson Insulation Inc.; AK Board.

f. Owens Corning; Fiberglas 700 Series.

C. Large Diameter Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. CertainTeed Corp.; CrimpWrap.

b. Johns Manville; MicroFlex.

c. Knauf Insulation; Pipe and Tank Insulation.

d. Manson Insulation Inc.; AK Flex.

e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.05 FIRE-RATED INSULATION SYSTEMS

A. Grease Duct Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested according to ASTM E2336.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Morgan Advanced Materials; Thermal Ceramics; FireMaster FastWrap XL and Pyroscat XL.

b. 3M Fire Protection Products; Fire Barrier Duct Wrap 615+.

c. Unifrax Corporation; FyreWrap Max 2.0.

B. Fire-Rated Plenum Wrap: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested, and designed to provide a single-layer, flexible enclosure around combustible items located within fire-rated return air plenums.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Unifrax Corporation; FyreWrap 0.5 Plenum Insulation.

b. 3M Fire Protection Products; Fire Barrier Plenum Wrap 5A+.

c. Morgan Advanced Materials; Thermal Ceramics; FireMaster PlenumWrap and PlenumWrap+.

2.06 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Insulco, Division of MFS, Inc.; SmoothKote.

b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.

c. Rock Wool Manufacturing Company; Delta One Shot.

2.07 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Aeroflex USA, Inc.; Aeroseal and Aeroseal LVOC.

b. Armacell LCC; 520 Adhesive.

c. Foster Products Corporation, H. B. Fuller Company; 85-75.

C. 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. Products: Subject to compliance with requirements, provide one of the products specified.

a. Childers Products, H.B. Fuller Company; CP-82.

b. Foster Products Corporation, H. B. Fuller Company; 85-20.

c. Johns Manville Industrial Insulation; S-90/80.

d. Marathon Industries, Inc.; 225.

e. Mon-Eco Industries, Inc.; 22-25.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Dow Chemical Company (The); 739, Dow Silicone.

b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

c. P.I.C. Plastics, Inc.; Welding Adhesive.

d. Red Devil, Inc.; Celulon Ultra Clear.

e. Speedline Corporation; Speedline Vinyl Adhesive.

2.08 **MASTICS**

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Childers Products, H.B. Fuller Company; CP-35.

b. Foster Products Corporation, H. B. Fuller Company; 30-90.

c. Johns Manville Industrial Insulation; CB-50.

d. Marathon Industries, Inc.; 590.

e. Mon-Eco Industries, Inc.; 55-40.

f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Childers Products, H.B. Fuller Company; CP-10.

b. Foster Products Corporation, H. B. Fuller Company; 35-00.

c. Johns Manville Industrial Insulation; CB-05/15.

d. Marathon Industries, Inc.; 550.

e. Mon-Eco Industries, Inc.; 55-50.

f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 200 deg F.

4. Solids Content: 63 percent by volume and 73 percent by weight.

5. Color: White.

2.09 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Childers Products, H.B. Fuller Company; CP-76-8.
    b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    c. Marathon Industries, Inc.; 405.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Childers Products, H.B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.10 FACTORY-APPLIED JACKETS

A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PSK Jacket: Metalized polypropylene, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.11 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Vimasco Corporation; Elastafab 894.
    b. Or approved equal.

B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Childers Products, H.B. Fuller Company; Chil-Glas No. 5.

b. Or approved equal.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.

b. Vimasco Corporation; Elastafab 894.

2.12 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

b. Lewco Products.

c. Mid-Mountain.

d. TCI.

2.13 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Airex Manufacturing, Inc.; E-Flex Guard.

b. Johns Manville; Zeston and Ceel-Co.

c. P.I.C. Plastics, Inc.; FG Series.

d. Proto PVC Corporation; LoSmoke.

e. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

4. Factory-fabricated tank heads and tank side panels.

E. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Airex Manufacturing, Inc.

b. Johns Manville; Zeston and Ceel-Co.

c. P.I.C. Plastics, Inc.; FG Series.

d. Proto PVC Corporation; LoSmoke.

e. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by manufacturer.

3. Color: White.
4. Factory-fabricated fitting covers:
    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

F. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Metal Jacketing Systems.
    b. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
    a. Sheet and roll stock ready for shop or field sizing 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.
    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) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
        3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    a. Sheet and roll stock ready for shop or field sizing factory cut and rolled to size.
    b. Material, finish, and thickness are indicated in field-applied jacket systems.
    c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
    e. Factory-Fabricated Fitting Covers:
        1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
        3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

G. Self-Adhesive Outdoor Jacket for Piping: Laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a fabric reinforced insulation cladding with natural aluminum stucco embossed facing.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. 3M VentureClad; 1579GCW-E.
    b. Polyguard; Alumaguard.

H. Self-Adhesive Outdoor Jacket for Ductwork: 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. Products: Subject to compliance with requirements, provide one of the products specified.
   a. MFM Building Products Corp.; FlexClad-400.
   b. Polyguard; Alumaguard.
   c. 3M VentureClad.

I. Sound Barrier Jacket: Uni-composite film laminated to 0.020 inch thick stucco embossed aluminum using viscoelastic film adhesive.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. PABCO-Childers Metals; Johns Manville Industrial Insulation; 1 pound Muffl-Jac.
2. Properties:
   a. Sound Transmission Class (STC): 29.
   b. Thickness (film): 0.080 to 0.110 inch.
   c. Weight (film): 1 pound per square foot.
   d. Service Temperature Range: Minus 40 deg F to 180 deg F.
3. Proprietary sound jacketing by steam pressure reducing valve manufacturer is also acceptable.

2.14 REMOVABLE AND REUSABLE INSULATION COVERS

A. Flexible Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of 4 inches of high temperature fiberglass insulation compressed between Teflon impregnated fiberglass inner and outer facing stitched with fiberglass core Teflon thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.

1. Fabricators:
   a. Apex Energy & Environmental Products Inc.
   b. 3i Supply Co.; K-Tex.
   c. Valley Group of Companies.

B. Rigid Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of rigid foam insulation with silicone impregnated fiberglass outer facing stitched with fiberglass thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.

1. Fabricators:
   a. Valley Group of Companies.

2.15 REMOVABLE AND REUSABLE ACOUSTIC INSULATION COVERS

A. Flexible Style: Custom fabricated composite jackets consisting of:

1. Two inches of high temperature, high density, needled fiberglass mat insulation.
2. High density mass loaded vinyl
3. Teflon impregnated fiberglass inner and outer facing with double sewn and bonded seams.
4. Extended Velcro flap on closing seams.
5. Stainless steel lacing hardware with wire twist fastener.

6. Include aluminum nameplate having embossed lettering with tag description.

B. Manufacturer:

1. Shannon Enterprises of W.N.Y. Inc.; INSULTECH; LT450A-TT Series.

2.16 **TAPES**

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.

b. 3M Venture Tape.

2. Width: 3 inches.

3. Thickness: 9 mils.

4. Adhesion: 70 ounces force/inch in width.

5. Elongation: 3 percent.

6. Tensile Strength: 45 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 rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.

b. 3M Venture Tape.

2. Width: 3 inches.

3. Thickness: 6 mils.

4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.

5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.

6. Elongation: 3 percent.

7. Tensile Strength: 35 lbf/inch in width.

8. 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. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 370 White PVC tape, or comparable products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.

b. 3M Venture Tape.

2. Width: 2 inches.

3. Thickness: 5 mils.

4. Adhesion: 20 ounces force/inch in width.

5. Elongation: 500 percent.
6. Tensile Strength: 15 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 488 AWF rubber adhesive or 788 Cold Seal acrylic adhesive, or comparable products by one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. 3M Venture Tape.
2. Width: 3 inches.
3. Thickness: 3.0 to 4.0 mils.
4. Adhesion (Rubber Adhesive): 90 ounces force/inch in width.
5. Adhesion (Acrylic Adhesive): 50 ounces force/inch in width.
6. Elongation: 3 percent.
7. Tensile Strength: 14 to 20 lbf/inch in width.

2.17 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Pab-Bands and Fabstraps.
   b. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing 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- diameter shank, length to suit depth of insulation indicated.
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) AGM Industries, Inc.; CWP-1.

2) GEMCO; Cupped Head Weld Pin.

3) Midwest Fasteners, Inc.; Cupped Head.

4) Nelson Stud Welding; CHP.

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. Products: Subject to compliance with requirements, provide one of the products specified.

      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.

      2) GEMCO; Perforated Base.

      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

   c. Spindle: Copper- or zinc-coated, low carbon 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. Products: Subject to compliance with requirements, provide one of the products specified.

      1) GEMCO; Nylon Hangers.

      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   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. Products: Subject to compliance with requirements, provide one of the products specified.

      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.

      2) GEMCO; Press and Peel.

      3) Midwest Fasteners, Inc.; Self Stick.

   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

   c. Spindle: Copper- or zinc-coated, low carbon 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 sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the products specified.

1) AGM Industries, Inc.; RC-150.

2) GEMCO; R-150.

3) Midwest Fasteners, Inc.; WA-150.

4) Nelson Stud Welding; Speed Clips.

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:

1) GEMCO.

2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers:

a. ACS Industries, Inc.

b. C & F Wire.

c. PABCO-Childers Metals; Johns Manville Industrial Insulation.

d. RPR Products, Inc.

2.18 **CORNER ANGLES**

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **PREPARATION**

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies 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.

3.03 **COMMON INSTALLATION REQUIREMENTS**

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at the 4 o’clock or 8 o’clock position on horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 thermal hanger 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 thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on the 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 as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Manholes.

5. Handholes.

6. Cleanouts.

3.04 **PENETRATIONS**

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade 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 through walls and partitions as detailed.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations:

1. Terminate ductwork insulation at angle closure of fire damper sleeves.
2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
   a. Firestopping is specified in Division 07 Section “Through-Penetration Firestop Systems.”

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
2. Pipe: Install insulation continuously through floor penetrations.
   a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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 shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 PVC fitting covers when available.

2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:

a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.

3. 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 PVC fitting covers when available.

2. When PVC fitting covers 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 PVC fitting covers when available.

2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.08 **DUCT AND PLENUM INSULATION INSTALLATION**

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. 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 over compress insulation during installation.

e. Impale insulation over pins and attach speed washers.

f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

2. 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 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

4. 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.

5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 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.

C. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.
3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer’s installation instructions.

3.09 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 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 over compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 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 latching mechanism.

2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.

3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. 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.

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 self-adhesive jackets are indicated, install according to manufacturer’s instructions and details on the drawings. Overlap seams arranged to shed water.

F. Where sound barrier jackets are indicated, install in accordance with manufacturer’s instructions.

3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, install two layers in strict accordance with manufacturer’s instructions, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors in strict accordance with insulation manufacturer’s to achieve same fire rating as duct.

C. Maintain a copy of insulation manufacturer’s installation instructions on site for Code Official.

D. Where fire-rated plenum wrap system is indicated, secure to system piping to maintain a continuous UL-listed fire rating.

E. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.12 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.

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.

END OF SECTION

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 ACTION SUBMITTALS 2
1.05 QUALITY ASSURANCE 2
1.06 DELIVERY, STORAGE, AND HANDLING 2
PART 2 PRODUCTS 2
2.01 VALVES, GENERAL 2
2.02 BRONZE BALL VALVES 4
2.03 GENERAL SERVICE BUTTERFLY VALVES 4
2.04 BRONZE CHECK VALVES 5
2.05 IRON SWING CHECK VALVES 5
2.06 LIFT CHECK VALVES 6
2.07 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES 7
2.08 BRONZE GLOBE VALVES 7
2.09 CAST-IRON GLOBE VALVES 8
2.10 CAST-IRON ANGLE VALVES 8
2.11 DRAIN VALVES 8
2.12 CHAINWHEEL ACTUATORS 8
2.13 SOURCE QUALITY CONTROL 9
PART 3 EXECUTION 9
3.01 EXAMINATION 9
3.02 VALVE INSTALLATION 9
3.03 JOINT CONSTRUCTION 9
3.04 ADJUSTING 9

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section "Mechanical Identification" for valve tags and charts.
2. Division 21 Fire-Suppression Piping and Fire Pump Sections for fire-protection valves.
3. Division 22 Piping Sections for specialty valves applicable to those Sections only.
4. Division 23 Section “General-Duty Valves for HVAC” for HVAC.
5. Division 23 Section "Temperature Controls" for control valves and actuators.

1.02 SUMMARY

A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.

4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.04 **ACTION SUBMITTALS**

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1. Certification that products for use in potable water systems comply with NSF 61 and NSF 372.

1.05 **QUALITY ASSURANCE**

A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.06 **DELIVERY, STORAGE, AND HANDLING**

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 **VALVES, GENERAL**

A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:

1. Shutoff Service: Ball, butterfly valves.
2. Throttling Service: Angle, ball, butterfly, or globe valves.

3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. For valves not indicated in the Application Schedules, select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Systems: Valve ends may be grooved.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted.

F. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.

1. Exceptions:
   a. Valves in pumped sanitary systems.
   b. Valves in pumped storm systems.
   c. Drain valves.
   d. Valves in general air or vacuum systems.
   e. Valves in irrigation systems.
   f. Valves in non-potable water systems.
   g. Valves in other plumbing systems not intended for human consumption.

G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

H. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

I. Extended Valve Stems: On insulated valves.

J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

K. Valve Grooved Ends: AWWA C606.

L. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

M. Threaded: With threads according to ASME B1.20.1.

N. Valve Bypass and Drain Connections: MSS SP-45.

2.02 **BRONZE BALL VALVES**

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 70LF-140/240.

b. Hammond Valve.

c. Kitz Corporation; Kitz Valves.

d. Milwaukee Valve Company; Model UPBA100S/150S.

e. NIBCO INC.; Models S-580-70-66-LF/T-580-70-66-LF.

f. Watts Water Technologies, Inc.

C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 77CLF-A Series.

b. Hammond Valve.

c. Kitz Corporation; Kitz Valves.

d. Milwaukee Valve Company; UPBA400S/450S.

e. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.

f. Watts Water Technologies, Inc.; Series LFB6080G2/LFB6081G2.

2.03 **GENERAL SERVICE BUTTERFLY VALVES**

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:

1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.

2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
b. Bray International, Inc.
c. DeZurik.
d. Emerson Automation Solutions; Keystone.
e. Forum Energy Technologies; ABZ Valve.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.; LD-2000-3/5.
i. Tyco Flow Control; Grinnell Flow Control.
j. Watts Water Technologies.

C. Grooved-End Butterfly Valves with EPDM-Encapsulated Ductile-Iron Disc: Ductile-iron body with grooved or shouldered ends and polyamide coating inside and outside; Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ASC Engineered Products.
   b. NIBCO INC.; Model GD-4765-3/5.
   c. Victaulic Co. of America.

2.04 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 125, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Model 162T-LF and 163T-LF (61YLF Series).
   b. Milwaukee Valve Company; Model UP509/UP1509.
   c. NIBCO INC.; Models S-413-B-LF or T-413-B-LF.
   d. Watts Water Technologies; LFCVY/LFCVYS.

2.05 IRON SWING CHECK VALVES

A. Iron Swing Check Valves, General: MSS SP-71.

B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.

d. Hammond Valve; IR1124-HI.

e. Milwaukee Valve Company; Model F-2974.

f. NIBCO INC.; Model F-918-B.

g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model 920F.

b. Crane Co.; Crane Valves.

c. Crane Co.; Stockham Div.

d. Hammond Valve; IR322.

e. Milwaukee Valve Company; Model F-2970.

f. NIBCO INC.; Model F-968-B.

g. Watts Water Technologies.

D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mueller Co.

b. NIBCO, INC.; Model G-917-W.

c. Victaulic Co. of America.

2.06 LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model CBV-LF (61LF Series).

b. Bonomi USA, Inc.; Series 100002 and 100003.

c. Hammond Valve; UP943 and UP947.

d. Milwaukee Valve Company; UP548T and UP1548T.

e. NIBCO INC.; Model S-480-Y-LF and T-480-Y-LF.

f. Watts Water Technologies; LF600.

2. Description:

a. Standard: MSS SP-80, Type 2.

b. CWP Rating: 250 psig.

c. Body Design: Vertical flow.

d. Body Material: Lead free brass or bronze.

e. Ends: Threaded or Solder.

f. Disc: PTFE, TFE, or Polyethermide.

2.07 **SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES**

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model W-910-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

C. Class 250, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 400 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model W-960-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

D. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-910-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

E. Class 250, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 400 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-960-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

2.08 **BRONZE GLOBE VALVES**

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 125, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model 121T-LF.

b. Hammond Valve; UP418 and UP440.

c. Milwaukee Valve Company; Model UP502 and UP1502.

d. Watts Water Technologies, Inc.; LFGLV.

2.09 CAST-IRON GLOBE VALVES

A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model 711F.

b. Crane Co.; Crane Valves.

c. Crane Co.; Stockham Valves.

d. Hammond Valve.

e. Milwaukee Valve Company; Model F-2981.

f. NIBCO INC.; Model F-718-B.

g. Watts Water Technologies, Inc.

2.10 CAST-IRON ANGLE VALVES

A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.

B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-818-B.

b. Crane Co.; Stockham Valves.

c. Crane Co.; Crane Valves.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Bronze ball valve as specified in this Section. Lead free construction is not required.

2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 CHAINWHEEL ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.

2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: Ductile iron , of type and size required for valve

2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

2.13 **SOURCE QUALITY CONTROL**

A. Identification: Factory label or color coding to identify lead free valves.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 **VALVE INSTALLATION**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Lift Check Valves: With stem upright and plumb.

3.03 **JOINT CONSTRUCTION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 **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.

END OF SECTION

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 PERFORMANCE REQUIREMENTS 2
1.05 SYSTEMS DESCRIPTION 2
1.06 ACTION SUBMITTALS 2
1.07 INFORMATIONAL SUBMITTALS 2
1.08 CLOSEOUT SUBMITTALS 2
1.09 QUALITY ASSURANCE 2
1.10 COORDINATION 3
PART 2 PRODUCTS 3
2.01 MANUFACTURERS 3
2.02 PIPING MATERIALS 3
2.03 COPPER TUBE AND FITTINGS 3
2.04 STAINLESS-STEEL PIPE AND FITTINGS 4
2.05 PEX PIPE AND FITTINGS 4
2.06 VALVES 4
PART 3 EXECUTION 5
3.01 EXCAVATION 5
3.02 PIPING SYSTEM INSTALLATION 5
3.03 JOINT CONSTRUCTION 5
3.04 HANGER AND SUPPORT INSTALLATION 5
3.05 CONNECTIONS 7
3.06 FIELD QUALITY CONTROL 7
3.07 ADJUSTING 8
3.08 CLEANING AND DISINFECTION 8

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods” for materials and methods common to mechanical piping systems.
3. Division 20 Section “Hangers and Supports.”
4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
5. Division 22 Section “General-Duty Valves for Plumbing.”
6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.02 SUMMARY

A. This Section includes domestic water piping inside the building.

1.03 DEFINITIONS

A. PEX: Crosslinked polyethylene plastic.

1.04 **PERFORMANCE REQUIREMENTS**

A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.05 **SYSTEMS DESCRIPTION**

A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.

B. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 22 Section “Facility Water Distribution.”

C. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.

2. Drain Duty: Hose-end drain valves.

3. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.

4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.

D. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.06 **ACTION SUBMITTALS**

A. Product Data: For pipe, tube, fittings, and couplings

1.07 **INFORMATIONAL SUBMITTALS**

A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.

2. Domestic water piping.

3. Compressed air piping.

4. HVAC hydronic piping.

1.08 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.09 **QUALITY ASSURANCE**

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

E. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.10 **COORDINATION**

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **PIPING MATERIALS**

A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 **COPPER TUBE AND FITTINGS**

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. 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.

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. 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.

C. Grooved-Joint Systems:

1. Manufacturers:
   a. ASC Engineered Solutions; Gruvlok; Fig. 64 CTS SlideLOK.
   b. Victaulic Company; Style 606 and Style 607.
2. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

D. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Viega North America; ProPress System.

b. NIBCO Inc.; Press System.

c. Mueller Industries, Inc.; Streamline PRS.

d. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.

e. Apollo Valves; by Conbraco Industries; ApolloXpress.

f. ASC Engineered Solutions; Anvil Press.

2. Housing: Copper.

3. O-Rings and Pipe Stops: EPDM.

4. Tools: Manufacturer's special tools.

5. Maximum 200-psig working-pressure rating at 250 deg F.

E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. T-DRILL Industries Inc.

2.04 STAINLESS-STEEL PIPE AND FITTINGS

A. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L

B. Seamless or electric resistance welded pipe.

B. Grooved-Joint Systems:

1. Manufacturers:

a. ASC Engineered Solutions; Gruvlok; Fig. 472 and Fig. 770.

b. Victaulic Company; Style 489.

2. Grooved-End, Stainless Steel-Piping Fittings: Schedule 10S, Type 304L or 316L stainless steel from material conforming to ASTM A 403 or pipe conforming to ASTM A 312, or sheet conforming to ASTM A 240; with dimensions matching stainless steel pipe.

3. Grooved-End, Stainless Steel-Piping Couplings: ASTM A 743, cast Type 316L stainless steel, EPDM gaskets, and stainless steel bolts and nuts.

a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 304L stainless steel.

2.05 PEX PIPE AND FITTINGS

A. PEX Distribution System: ASTM F 876 and ASTM F 877, SDR 9 tubing.

1. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper crimp rings and matching PEX tube dimensions; or plastic-insert type cold expansion fittings and corresponding rings, material meeting requirements of ASTM F 1960.

2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877 and with plastic or corrosion-resistant-metal valve for each outlet.

2.06 VALVES

A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."

B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.02 PIPING SYSTEM INSTALLATION

A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Install under-building-slab copper tubing according to Copper Development Association's "Copper Tube Handbook." Joints under slab are not allowed. Install PVC sleeve where piping penetrates slab.

C. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 20 Section "Basic Mechanical Materials and Methods."

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."

F. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.

G. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.

2. Install stop-and-waste drain valves where indicated.

H. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

I. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 22 Section "Domestic Water Piping Specialties."

J. Install domestic water piping level without pitch and plumb.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. PEX Piping Joints: Join according to ASTM F 1807.

3.04 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

7. NPS 6: 12 feet with 3/4-inch rod.

8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

F. Install supports for vertical steel piping every 15 feet.

G. Install hangers for drawn-temper copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60-inches with 3/8-inch rod.

2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

4. NPS 2-1/2: 108 inches with 1/2-inch rod.

5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

6. NPS 6: 10 feet with 5/8-inch rod.

7. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

J. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

K. Install hangers for Schedule 10 stainless steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.

2. NPS 2-1/2: 84 inches with 1/2-inch rod.

3. NPS 3: 96 inches with 1/2-inch rod.

4. NPS 4: 10 feet with 5/8-inch rod.

5. NPS 6: 11 feet with 3/4-inch rod.

6. NPS 8: 12 feet with 7/8-inch rod.
7. NPS 10 to NPS 12: 14 feet with 7/8-inch rod.

L. Install supports for vertical Schedule 10 stainless steel piping every 15 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 **CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section “Basic Mechanical Materials and Methods” for dielectric fittings.

C. Install piping adjacent to equipment and machines to allow service and maintenance.

D. Connect domestic water piping to the following:

1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
2. 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. Booster Pumps: Cold-water suction and discharge piping.
4. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3.06 **FIELD QUALITY CONTROL**

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave 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.

4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.07 **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 flow of hot water in each branch.
      b. Adjust calibrated balancing valves to flows indicated.
   5. Remove plugs used during testing of piping and plugs used 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.

3.08 **CLEANING AND DISINFECTION**

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
B. Clean and disinfect potable and non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 PERFORMANCE REQUIREMENTS 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 2
1.05 CLOSEOUT SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
PART 2 PRODUCTS 2
2.01 VACUUM BREAKERS 2
2.02 BACKFLOW PREVENTERS 3
2.03 BALANCING VALVES 5
2.04 TEMPERATURE-ACTUATED WATER MIXING VALVES 6
2.05 PREPIPED TEMPERED WATER MIXING SYSTEM 7
2.06 STRAINERS FOR DOMESTIC WATER PIPING 7
2.07 OUTLET BOXES 8
2.08 HOSE BIBBS 9
2.09 WALL HYDRANTS 9
2.10 WATER HAMMER ARRESTERS 10
2.11 AIR VENTS 11
2.12 DOMESTIC WATER CARTRIDGE FILTERS 11
PART 3 EXECUTION 11
3.01 INSTALLATION 12
3.02 DOMESTIC WATER CARTRIDGE-FILTER INSTALLATION 12
3.03 CONNECTIONS 12
3.04 LABELING AND IDENTIFYING 13
3.05 FIELD QUALITY CONTROL 13
3.06 ADJUSTING 13

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 22 Section "Domestic Water Piping " for water meters.
5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
6. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Flow Reports and Settings: For calibrated balancing valves.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
3. Comply with NSF 372, “Drinking Water System Components – Lead Content” for components with wetted surfaces in contact with potable water.

PART 2 PRODUCTS

2.01 **VACUUM BREAKERS**

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Watts Regulator Co.
   d. Zurn Plumbing Products Group; Wilkins Div.
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.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. MIFAB, Inc.
   c. Watts Water Technologies, Inc.; Watts Regulator Co.

d. Woodford Manufacturing Company.

2. Standard: ASSE 1011.
3. Body: Bronze or brass, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
   d. Watts Water Technologies, Inc.; Watts Regulator Co.
   e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacity: As indicated on the drawings.
6. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.02 **BACKFLOW PREVENTERS**

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Watts Regulator Co.
   d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 or NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.

d. Watts Water Technologies, Inc.; Watts Regulator Co.

e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

5. Size and Capacities: As scheduled on the drawings.

6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

8. Configuration: Designed for horizontal, straight through flow.

9. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

c. Y-Pattern strainer and soft-seated check valve.

C. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.

b. FEBCO; a Division of Watts Water Technologies, Inc.

c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.

d. Watts Water Technologies, Inc.; Watts Regulator Co.

e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.

3. Operation: Continuous-pressure applications, unless otherwise indicated.

4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

5. Size and Capacities: As scheduled on the drawings.

6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

8. Configuration: Designed for horizontal, straight through flow.

9. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.

b. Watts Water Technologies, Inc.; Watts Regulator Co.

c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel or Acetal plastic.
6. End Connections: Threaded.

E. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. Watts Water Technologies, Inc.; Watts Regulator Co.
   c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.03 **BALANCING VALVES**

A. Calibrated Balancing Valves NPS 1/2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Armstrong Pumps, Inc.
   c. Apollo Valves; by Conbraco Industries, Inc.
   d. Bell & Gossett; Xylem Inc.
   e. Flo Fab Inc.
   f. Flow Design Inc.
   g. Griswold Controls.
   h. NIBCO INC.
   i. IMI Indoor Climate; Tour & Andersson.
   j. Taco, Inc.
   k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Minimum Flow Rate: 0.3 gpm.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Calibrated Balancing Valves NPS 3/4 to NPS 2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.

b. Armstrong Pumps, Inc.
c. Apollo Valves; by Conbraco Industries, Inc.
d. Bell & Gossett; Xylem Inc.
e. Flo Fab Inc.
f. Flow Design Inc.
g. Griswold Controls.
h. NIBCO INC.
i. IMI Indoor Climate; Tour & Andersson.
j. Taco, Inc.
k. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant 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.

C. Calibrated Balancing Valves NPS 2-1/2 to NPS 4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Bell & Gossett; Xylem Inc.
   c. Flo Fab Inc.
   d. Flow Design Inc.
   e. Griswold Controls.
   f. NIBCO INC.
   g. IMI Indoor Climate; Tour & Andersson.
   h. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.04 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Controls; Morris Group International; ST70.
   b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
   c. Bradley Corporation.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company; Series 170-LF and 270-LF.

f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.

g. Watts Water Technologies, Inc.; Watts Regulator Co.

h. Zurn Plumbing Products Group; Wilkins Div.

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: 1/2-inch union or 3/8-inch compression; with integral check valves.

7. Accessories: Adjustable temperature-control knob.

8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.

9. Minimum Flow Rate: 0.5 gpm.

10. Valve Finish: Chrome plated

2.05 PREPIPED TEMPERED WATER MIXING SYSTEM

A. General

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Controls; Morris Group International.

b. Armstrong International, Inc. (RADA).

c. Bradley Corporation.

d. Lawler Manufacturing Company, Inc.; Pre-piped 802 Hi-Low Tempered water Mixing System.

e. Leonard Valve Company.

f. Symmons Industries, Inc.

g. Watts Water Technologies, Inc.; Powers Division.

h. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Description: Completely assembled and tested pre-piped manifold system including mixing valve(s), recirculation pump, circuit setting balancing valve, aquastat, circulator switch box, thermometers, isolation valves, mounting strut, and test connection.

3. Standard: ASSE 1017.

4. Mixing Valve: Exposed-mounting, thermostatically controlled water mixing valve.

a. Material: Bronze body with corrosion-resistant interior components.

b. Connections: Threaded union inlets and outlet.

c. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.

d. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.

e. Size, Settings, and Capacities: As scheduled on the drawings.

f. Valve Finish: Rough bronze.

2.06 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. Keckley Company.
    c. Metraflex Company.
    d. Mueller Steam Specialty; a Watts Brand.
    e. NIBCO, Inc.
    f. Titan Flow Control, Inc.
    g. Watts.
    h. Yarway; Emerson Automation Solutions.
2. CWP: 200 psig minimum, unless otherwise indicated.
3. SWP: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Screen: Stainless steel with round perforations, unless otherwise indicated.
7. Perforation Size:
    a. Strainers NPS 2 and Smaller: 0.033 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 5 and Larger: 0.045 inch.
8. Drain: Pipe plug.

2.07 OUTLET BOXES

A. Clothes Washer Outlet Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
    b. Oatey SCS.
    c. Guy Gray Manufacturing Co., Inc.
2. Mounting: Recessed.
3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
4. 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.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
   b. Oatey SCS.
   c. LSP Products Group, Inc.
   d. Acorn Engineering Company.
2. Mounting: Recessed.
3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.08 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.09 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.

e. Watts Water Technologies, Inc.; Watts Regulator co.

f. Woodford Manufacturing Company.

g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for 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 mounting with cover.

9. Box and Cover Finish: Polished nickel bronze or chrome plated.

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.

12. Operating Keys(s): Two with each wall hydrant.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MIFAB, Inc.

b. PPP Inc.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Copper tube with piston.

4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.

b. Josam Company.

c. MIFAB, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Precharged stainless steel bellows.

4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 **AIR VENTS**

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.

2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.

3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.

5. Size: NPS 3/8 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.

2. Pressure Rating: 150-psig minimum pressure rating.

3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.

5. Size: NPS 3/8 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

2.12 **DOMESTIC WATER CARTRIDGE FILTERS**

A. Off-Floor Cartridge Filters:

1. Manufacturers:

a. Culligan International Company.

b. Harmsco Filtration Products.

c. Osmonics, Inc.; Hytrex Filters Div.

d. Parker Hannifin Corporation; Process Filtration Div.

e. Water Equipment Technologies (WET); Xylem Inc.

f. Watts Premier.

2. Description: Simplex, in-line housing with replaceable element for removing suspended particles from water.

a. Housing: Corrosion resistant; designed to separate feedwater from filtrate and to direct feedwater through water filter element; with element support.

1) Pipe Connections: Threaded according to ASME B1.20.1.

2) Support: Wall bracket.

b. Element: Replaceable; of shape to fit housing.

3. Capacity and Characteristics:

a. Refer to locations specified on Drawings.

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Do not install bypass piping around backflow preventers.

4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.

C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of pump.

G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

H. Install water hammer arresters in water piping according to PDI-WH 201.

I. Install air vents at high points of water piping.

3.02 **DOMESTIC WATER CARTRIDGE-FILTER INSTALLATION**

A. Install cartridge filters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Attach wall brackets for off-floor, wall-mounting, cartridge filter to vertical surface. Attach housing(s), and base if any, to wall bracket.

C. Install housings for off-floor, in-line, cartridge filters in piping.

D. Install isolation valves on inlet and outlet piping of each water filter.

E. Install filter elements in cartridges after completion of flushing and cleaning.

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 **LABELING AND IDENTIFYING**

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Carbonated-beverage-machine backflow preventers.
5. Dual-check-valve backflow preventers.
6. Calibrated balancing valves.
7. Primary, thermostatic, water mixing valves.
8. Outlet boxes.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.05 **FIELD QUALITY CONTROL**

A. Perform the following tests and prepare test reports:

1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.06 **ADJUSTING**

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves as follows:

1. Set calibrated balancing valves at calculated presettings.
2. Measure flow each station and adjust where necessary.
3. Record settings and mark balancing devices.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 PERFORMANCE REQUIREMENTS 2
1.04 SYSTEMS DESCRIPTIONS 2
1.05 ACTION SUBMITTALS 2
1.06 INFORMATIONAL SUBMITTALS 2
1.07 CLOSEOUT SUBMITTALS 2
1.08 QUALITY ASSURANCE 2
1.09 PROJECT CONDITIONS 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS 3
2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS 3
2.04 STAINLESS-STEEL PIPE AND FITTINGS 3
2.05 DUCTILE-IRON PIPE AND FITTINGS 3
2.06 PVC PIPE AND FITTINGS 4
2.07 SPECIALTY PIPE FITTINGS 4
2.08 ENCASEMENT FOR UNDERGROUND METAL PIPING 5
PART 3 EXECUTION 5
3.01 EXCAVATION 5
3.02 PIPING SYSTEM INSTALLATION 5
3.03 JOINT CONSTRUCTION 6
3.04 SPECIALTY PIPE FITTING INSTALLATION 6
3.05 VALVE INSTALLATION 7
3.06 HANGER AND SUPPORT INSTALLATION 7
3.07 CONNECTIONS 8
3.08 IDENTIFICATION 9
3.09 FIELD QUALITY CONTROL 9
3.10 CLEANING 10
3.11 PROTECTION 10

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements”.
2. Division 20 Section “Basic Mechanical Materials and Methods”.
3. Division 22 Section “Drainage Piping Specialties”.
4. Division 22 Section "Sewage Pumps."
5. Division 22 Section “Sanitary Waste and Vent Piping” for piping outside building.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.03 **PERFORMANCE REQUIREMENTS**

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

2. Sanitary Sewer, Force-Main Piping: 125 psig.

1.04 **SYSTEMS DESCRIPTIONS**

A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.05 **ACTION SUBMITTALS**

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings:

1. Sovent Drainage System: Include plans, elevations, sections, and details.

1.07 **CLOSEOUT SUBMITTALS**

A. Field quality-control inspection and test reports.

1.08 **QUALITY ASSURANCE**

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

1.09 **PROJECT CONDITIONS**

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.

2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

A. Pipe and Fittings: ASTM A 74, Service class.

B. Pipe and Fittings: ASTM A 74, Extra-Heavy class.

C. Gaskets: ASTM C 564, rubber.

2.03 **HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers:

a. ANACO-Husky; McWane Plumbing Group.

b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).

c. IDEAL-TRIDON.

d. MIFAB, Inc.

e. Mission Rubber Company; a division of MCP Industries, Inc.

f. Tyler Pipe; McWane Plumbing Group.

g. Fernco Inc.

2. Standards: CISPI 310.

3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:

a. ANACO-Husky; McWane Plumbing Group; SD 4000.

b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).

c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.

d. Norma Group; Clamp-All Products; HI-TORQ 125.

2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 **STAINLESS-STEEL PIPE AND FITTINGS**

A. Manufacturer:

1. Blucher-Josam.

B. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.

C. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.

1. Material: EPDM, unless NBR is indicated.

2.05 **DUCTILE-IRON PIPE AND FITTINGS**

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Flanges: ASME 16.1, Class 125, cast iron.

2.06 **PVC PIPE AND FITTINGS**

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

2.07 **SPECIALTY PIPE FITTINGS**

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.

b. Fernco, Inc.

c. Logan Clay Products Company (The).

d. Mission Rubber Co.

e. NDS, Inc.

f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.

D. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. SIGMA Corp.

2.08 **ENCASEMENT FOR UNDERGROUND METAL PIPING**

A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.

B. Form: Sheet or tube.

C. Color: Black or natural.

PART 3 EXECUTION

3.01 **EXCAVATION**

A. Comply with requirements in Division 31 Section “Earth Moving” for excavating, trenching, and backfilling.

3.02 **PIPING SYSTEM INSTALLATION**

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Sanitary sewer piping outside the building is specified in Division 22 Section "Sanitary Sewerage."

C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

H. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.

L. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

N. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

O. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

P. Install underground ABS soil and waste drainage piping according to ASTM D 2321.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.

b. NPS 2 and Larger: Pressure transition couplings.

3.05 **VALVE INSTALLATION**

A. General valve installation requirements are specified in Division 20 Section "Valves."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.

2. Install gate valve or butterfly 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 sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.

2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.

3. Install backwater valves in accessible locations.

4. Backwater valves are specified in Division 22 Section "Drainage Piping Specialties."

3.06 **HANGER AND SUPPORT INSTALLATION**

A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Install individual, straight, horizontal piping runs according to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 3: 96 inches with 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.
4. NPS 6: 10 feet with 5/8-inch rod.

J. Install supports for vertical stainless-steel piping every 10 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

N. Alternate support for plastic piping: Continuous support 18 gauge v-shaped galvanized steel channel, maximum hanger spacing 8 feet.

O. Install supports for vertical PVC piping every 48 inches.

P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 **CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.

3.08 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.09 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 **CLEANING**

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 **PROTECTION**

A. Exposed Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 ACTION SUBMITTALS 2
1.04 CLOSEOUT SUBMITTALS 2
1.05 QUALITY ASSURANCE 2
1.06 COORDINATION 2
PART 2 PRODUCTS 2
2.01 CAST-IRON CLEANOUTS 2
2.02 FLOOR DRAINS 4
2.03 FLOOR SINKS 6
2.04 AIR-ADMITTANCE VALVES 7
2.05 ROOF FLASHING ASSEMBLIES 7
2.06 TRAP SEAL PROTECTION DEVICES 7
2.07 ROOF DRAINS 8
2.08 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES 9
2.09 FLASHING MATERIALS 10
2.10 GREASE INTERCEPTORS 10
2.11 SOLIDS INTERCEPTORS 11
PART 3 EXECUTION 11
3.01 CONCRETE BASES 11
3.02 INSTALLATION 12
3.03 CONNECTIONS 13
3.04 FLASHING INSTALLATION 14
3.05 LABELING AND IDENTIFYING 14
3.06 FIELD QUALITY CONTROL 14
3.07 PROTECTION 14
3.08 DEMONSTRATION 15

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PUR: Polyurethane plastic.

H. PVC: Polyvinyl chloride plastic.

1.03 **ACTION SUBMITTALS**

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.04 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.05 **QUALITY ASSURANCE**

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

D. Comply with ASPE/ANSI 45-2013 “Siphonic Roof Drainage” for siphonic roof drainage systems.

1.06 **COORDINATION**

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 **CAST-IRON CLEANOUTS**

A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.

B. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.; Series 58910.
    b. MIFAB, Inc.; C1460.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.

C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.; C1220-R.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.

3. Type: Adjustable housing.

4. Body or Ferrule: Cast iron.

5. Clamping Device: Not required.

6. Outlet Connection: Spigot.

7. Closure: Brass, bronze, or plastic plug with tapered threads.

8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.

9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.

10. Frame and Cover Shape: Round.

11. Top Loading Classification: Medium Duty.

12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Cast–Iron Floor Cleanouts (Not-On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.

b. MIFAB, Inc.; C-1100-C-R-34.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4333C.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.

3. Type: Adjustable housing.

4. Body or Ferrule: Cast iron.

5. Clamping Device: Required.

6. Outlet Connection: Spigot.

7. Closure: Brass, bronze, or plastic plug with tapered threads.

8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.

9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.

10. Frame and Cover Shape: Round.

11. Top Loading Classification: Medium Duty.

12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

E. Cast-Iron Wall Cleanouts (Finished Wall Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.; Model 58790-20.
    b. MIFAB, Inc.; C1460-RD.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.02 **FLOOR DRAINS**

A. Cast-Iron Floor Drains (Toilet Rooms, Labs, and Janitor's Closet) FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-B.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Square, with vandal proof screws.
12. Dimensions of Top or Strainer: 7 inch square.

13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.
15. Trap-Seal Primer Valve Fitting:
    a. Description: Cast iron, with spigot inlet and spigot outlet, and trap-seal primer valve connection.
    b. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Cast-Iron Floor Drains (Showers) FD-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-B.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Square, with vandal proof screws.
12. Dimensions of Top or Strainer: 5 inch square.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.
15. Trap-Seal Primer Valve Fitting:
    a. Description: Cast iron, with spigot inlet and spigot outlet, and trap-seal primer valve connection.
    b. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Cast-Iron Floor Drains (Mechanical Rooms, Electrical Rooms, and Penthouses) FD-3:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2142.

d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.

3. Pattern: Floor drain.

4. Body Material: Gray iron.

5. Seepage Flange: Required.

6. Clamping Device: Required.

7. Outlet: Bottom unless otherwise noted.

8. Coating on Interior and Exposed Exterior Surfaces: Enamel.

9. Sediment Bucket: 3-3/4 inches deep, slotted sediment bucket with lift bar.

10. Top or Strainer Material: Cast-iron.

11. Top Shape: Round.

12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area. Provide partial grate where required to accept equipment drains.

13. Top Loading Classification: Heavy Duty.

14. Outlet Fitting: Gray iron, with spigot outlet.

15. Trap-Seal Primer Valve Fitting:

a. Description: Cast iron, with spigot inlet and spigot outlet, and trap-seal primer valve connection.

b. Size: Same as floor drain outlet with NPS 1/2 side inlet.

2.03 **FLOOR SINKS**

A. Stainless-Steel Floor Sink Drains FS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 3006-12.

d. Tyler Pipe; Wade Div.

e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.

3. Outlet: Bottom unless otherwise noted.

4. Top or Strainer Material: Stainless steel.

5. Top Shape: Square.

6. Dimensions of Top or Strainer: 12 inch by 12 inch, 14 gage, Type 304 stainless steel ribbed, non-tilt loose set half grate with 1/2 inch square holes and perforated stainless steel sediment bucket.

7. Seepage Flange: Required.

8. Clamping Device: Required.

9. Trap-Seal Primer Valve Fitting:
    a. Description: Cast iron, with spigot inlet and spigot outlet, and trap-seal primer valve connection.
    b. Size: Same as floor drain outlet with NPS 1/2 side inlet.

2.04 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Ayrlett, LLC.
    b. Durgo, Inc.
    c. Oatey.
    d. ProSet Systems Inc.
    e. RectorSeal.
    f. 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.

2.05 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Acorn Engineering Company; Elmdor/Stoneman Div.
    b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 6 inches from pipe, with boot reinforcement and counterflashing fitting.
1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.06 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
    b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.
2. Standard: ASSE 1072-2007.
3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.07 **ROOF DRAINS**

A. Metal Roof Drains RD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1015/1074.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Flow-Control Weirs: Not required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.

B. Metal Secondary Roof Drains ORD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1015/1074.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Flow-Control Weirs: Not required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.

10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.
13. Standpipe: Cast iron. 2 inches high where overflow drains are indicated.

2.08 **MISCELLANEOUS DRAINAGE PIPING SPECIALTIES**

A. Hub Outlets:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
    a. NPS 2: 4-inch- minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 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.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. 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.

G. Expansion Joints:

1. Standard: ASME A112.21.2M.
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.

H. Conductor Nozzles DNZ-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1770-NB-BS.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.; RD-940-83.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Description: Bronze body with threaded inlet, bronze wall flange with mounting holes, and bird screen.
3. Size: Same as connected conductor.

2.09 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.10 GREASE INTERCEPTORS

A. Grease Interceptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lowe Engineering; a div. of Highland Tank & Manufacturing Co., Inc.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.

2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation or -processing wastewater.
3. Plumbing and Drainage Institute Seal: Required.
4. Body Material: Stainless steel.
5. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
7. Body Extension: As required.
8. Size and Capacities: As indicated on the drawings.
9. Cleanout: Integralor field installed on outlet.Mounting: Recessed, flush with floor.
11. Flow-Control Fitting: Required.
12. Operation: Manual cleaning.

2.11 SOLIDS INTERCEPTORS

A. Solids Interceptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Striem.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Type: Factory-fabricated interceptor made for removing and retaining sediment from wastewater.
3. Body Material: Cast iron, steel, or polypropylene.
4. Interior Separation Device: Screens.
5. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
7. Size and Capacities: As indicated on the drawings.
8. Mounting: Above floor.

PART 3 EXECUTION

3.01 CONCRETE BASES

A. Anchor interceptors to concrete bases.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.

2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.02 **INSTALLATION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install fixture air-admittance valves on fixture drain piping.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.

2. Position roof drains for easy access and maintenance.

I. Assemble open drain fittings and install with top of hub 2 inches above floor.

J. Install deep-seal traps on floor drains and other waste outlets, if indicated.

K. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

N. Install vent caps on each vent pipe passing through roof.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

Q. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.

2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

R. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.

S. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

T. Install wood-blocking reinforcement for wall-mounting-type specialties.

U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

V. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

W. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.04 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.05 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Solids interceptors.

2. Grease interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.07 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.

3.08 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices.

END OF SECTION

SECTION 22 1413 - STORM DRAINAGE PIPING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 PERFORMANCE REQUIREMENTS 1
1.04 SYSTEMS DESCRIPTIONS 2
1.05 ACTION SUBMITTALS 2
1.06 INFORMATIONAL SUBMITTALS 2
1.07 CLOSEOUT SUBMITTALS 2
1.08 QUALITY ASSURANCE 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS 2
2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS 2
2.04 PVC PIPE AND FITTINGS 3
PART 3 EXECUTION 3
3.01 EXCAVATION 3
3.02 PIPING SYSTEM INSTALLATION 3
3.03 JOINT CONSTRUCTION 4
3.04 CONNECTIONS 5
3.05 FIELD QUALITY CONTROL 5
3.06 CLEANING 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section “Drainage Piping Specialties.”
4. Division 22 Section "Sump Pumps."
5. Division 33 Section “Storm Utility Drainage Piping” for piping outside building.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 125 psig.

1.04 **SYSTEMS DESCRIPTIONS**

A. Storm drainage piping system materials are scheduled on the Drawing.

1.05 **ACTION SUBMITTALS**

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings:

1. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

1.07 **CLOSEOUT SUBMITTALS**

A. Field quality-control inspection and test reports.

1.08 **QUALITY ASSURANCE**

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with “NSF-dwv” for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

A. Pipe and Fittings: ASTM A 74, Service class.

B. Pipe and Fittings: ASTM A 74, Extra-Heavy class.

C. Gaskets: ASTM C 564, rubber.

2.03 **HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. CISPI, Hubless-Piping Couplings:

1. Manufacturers:

a. ANACO-Husky; McWane Plumbing Group.

b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).

c. IDEAL-TRIDON.

d. MIFAB, Inc.

e. Mission Rubber Company; a division of MCP Industries, Inc.

f. Tyler Pipe; McWane Plumbing Group.

2. Standards: CISPI 310.

3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:

a. ANACO-Husky; McWane Plumbing Group; SD 4000.

b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).

c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.

d. Norma Group; Clamp-All Products; HI-TORQ 125.

2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 **PVC PIPE AND FITTINGS**

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drainpipe.

PART 3 EXECUTION

3.01 **EXCAVATION**

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 **PIPING SYSTEM INSTALLATION**

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, copper, force-main tubing according to Copper Development Association's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

J. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.

2. Horizontal Storm-Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.

M. Install force mains at elevations indicated.

N. Install engineered controlled-flow storm drainage piping in locations indicated.

O. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

P. Install ABS storm drainage piping according to ASTM D 2661.

Q. Install PVC storm drainage piping according to ASTM D 2665.

R. Install underground PVC storm drainage piping according to ASTM D 2321.

S. Install underground ABS storm drainage piping according to ASTM D 2321.

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 **JOINT CONSTRUCTION**

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 **CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Storm Sewer: To exterior force main or storm manhole.

2. Sump Pumps: To sump pump discharge.

3.05 **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.

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 storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.06 **CLEANING**

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 2
1.03 ACTION SUBMITTALS 2
1.04 INFORMATIONAL SUBMITTALS 2
1.05 CLOSEOUT SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
PART 2 PRODUCTS 3
2.01 WATER CLOSETS 3
2.02 BATTERY OPERATED SENSOR WATER CLOSET FLUSHOMETERS 3
2.03 URINALS 4
2.04 BATTERY OPERATED SENSOR URINAL FLUSHOMETERS 4
2.05 TOILET SEATS 5
2.06 LAVATORIES 5
2.07 LAVATORY FAUCETS 6
2.08 COUNTER-MOUNTING SINKS 7
2.09 SERVICE SINKS 7
2.10 SINK FAUCETS 8
2.11 FIXTURE SUPPLIES 9
2.12 PROTECTIVE SHIELDING GUARDS 9
2.13 FIXTURE SUPPORTS 10
PART 3 EXECUTION 11
3.01 EXAMINATION 11
3.02 INSTALLATION 11
3.03 CONNECTIONS 12
3.04 FIELD QUALITY CONTROL 12
3.05 ADJUSTING 12
3.06 CLEANING 12
3.07 PROTECTION 13

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 22 Section "Emergency Plumbing Fixtures."
5. Division 22 Section "Drinking Fountains and Water Coolers."
6. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
7. Division 22 Section “Drainage Piping Specialties” for floor drains, and specialty fixtures not included in this Section.
8. Division 22 Section "Water Distribution" for exterior plumbing fixtures and hydrants.

1.02 **DEFINITIONS**

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.03 **ACTION SUBMITTALS**

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Diagram power, signal, and control wiring.

B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

PART 2 PRODUCTS

2.01 WATER CLOSETS

A. Water Closets, WC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. American Standard Companies, Inc.; Madera FloWise 16-1/2” Elongated Toilet.
    b. Kohler Co.; Highcliff Ultra K-96057.
    c. Sloan Valve Company.
    d. Zurn Plumbing Products Group.
2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
    a. Style: Flushometer valve.
        1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
        2) Supply Spud Location: Top
        3) Height: 16-1/2 to 16-3/4 inches, universal/accessible.
        4) Design Consumption: 1.28 gal./flush or 1.6 gal./flush.
        5) Color: White.
    b. Flushometer: FV-2-2.
    c. Toilet Seat: TS-1.

2.02 BATTERY OPERATED SENSOR WATER CLOSET FLUSHOMETERS

A. Flushometers, FV-2-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. American Standard Companies, Inc.
    b. Delany Products.
    c. Delta Faucet Company; 81T201BTA-MMO.
    d. Kohler Co. Wave.
    e. Moen Commercial.
    f. Sloan Valve Company.
    g. Speakman Company.

h. Zurn Plumbing Products Group.

2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, courtesy flush feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm or piston operation.

b. Style: Exposed.

c. Inlet Size: NPS 1.

d. Trip Mechanism: Battery-operated sensor actuator.

e. Consumption: 1.6 gal./flush.

f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.03 URINALS

A. Urinals, UR-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.; Washbrook Urinal System.

b. Kohler Co.; Bardon K 4991-ETSS.

c. Sloan Valve Company.

d. Zurn Industries, Inc.; EcoVantage.

2. Description: Wall-mounting, back-outlet, ultra-low water consumption, vitreous-china fixture designed for flushometer valve operation.

a. Type: High efficiency.

b. Strainer or Trapway: Open trapway with integral trap.

c. Design Consumption: Operates in the range of 1/8 gal./flush to 1 gal./flush.

d. Color: White.

e. Supply Spud Size: NPS 3/4.

f. Supply Spud Location: Top.

g. Outlet Size: NPS 2.

h. Flushometer: FV-1-2.

i. Fixture Support: Urinal chair carrier.

2.04 BATTERY OPERATED SENSOR URINAL FLUSHOMETERS

A. Flushometers, FV-1-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.

b. Delany Products.

c. Delta Faucet Company; 81T231BTA-MMO.

d. Kohler Co.

e. Moen Commercial.

f. Sloan Valve Company.

g. Speakman Company.

h. Zurn Plumbing Products Group.

2. Description: Flushometer for urinal -type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, courtesy flush feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm or piston operation.

b. Style: Exposed.

c. Inlet Size: NPS 3/4.

d. Trip Mechanism: Battery-operated sensor actuator.

e. Consumption: 1.0 gal./flush.

f. Tailpiece Size: NPS 3/4 and standard length to top of fixture.

2.05 TOILET SEATS

A. Toilet Seats, TS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bemis Manufacturing Company; 1955SSC/1955SSCT.

b. Centoco Manufacturing Corp.

c. Church Seats; 295SSC/295SSCT.

d. Comfort Seats; a Jones Stephens Brand; Model Number C106SSC.

e. Ferguson Enterprises, Inc.; ProFlo PFTSCOF2000WH.

f. Olsonite Seat Company; Model 10SSC/10SSCT.

g. Plumbtech; Plumbing Technologies, LLC.

h. Sanderson Plumbing Products, Inc.; Beneke Div.

i. Zurn Plumbing Products Group; 5955STS-WH.

2. Description: Toilet seat for water-closet-type fixture.

a. Material: Molded, solid plastic.

b. Configuration: Open front without cover.

c. Size: Elongated.

d. Hinge Type: SC, self-sustaining, check.

e. Class: Standard commercial.

f. Color: White.

2.06 LAVATORIES

A. Lavatories, LAV-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. American Standard Companies, Inc.; Lucerne Model 0355.012.
    b. Ferguson Enterprises, Inc.; ProFlo PF5504.
    c. Kohler Co.; K 2005 Kingston.
    d. Sloan Valve Company.
    e. Zurn Plumbing Products Group; Z5344.
2. Description: Accessible, wall-mounting, vitreous-china fixture.
    a. Type: With contoured back and side shields.
    b. Size: 20 by 18 inches rectangular.
    c. Faucet Hole Punching: Three holes, 2-inch centers.
    d. Color: White.
    e. Faucet: LF-1.
    f. Water Temperature Limiting Device: Required.
    g. Drain: Grid.
    h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
    i. Fixture Support: Lavatory with concealed arms.

2.07 LAVATORY FAUCETS

A. Lavatory Faucets, LF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. American Standard Companies, Inc.; Reliant 3 Model 7385.003/7385.043.
    b. Chicago Faucets.
    c. Delta Faucet Company; Model 523LF-HDF.
    d. Kohler Co.
    e. Moen Commercial.
    f. Speakman Company; Model S-3561.
    g. T & S Brass and Bronze Works, Inc.; B-2711.
    h. Zurn Plumbing Products Group; Z7440.
2. Description: Single handle mixing faucet, vandal resistant, 2 or 3 holes, with metal grid strainer, no lift rod hole, high temperature limit stop.
    a. Body Material: Commercial, all metal construction meeting NSF 61.
    b. Finish: Polished chrome plate.
    c. Centers: 4 inches.
    d. Mounting: Deck, concealed.
    e. Inlet(s): NPS 1/2.

f. Spout Outlet:

1) Vandal resistant aerator.

2) Laminar flow or plain end for patient care areas.

g. Maximum Flow Rate:

1) 0.5 gpm for faucets in public restrooms.

2) 1.5 gpm.

2.08 COUNTER-MOUNTING SINKS

A. Sinks, SK-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Co.

b. Franke Consumer Products, Inc., Commercial Div.

c. Just Manufacturing Company.

d. Moen Commercial.

2. Description: Single-bowl, counter-mounting, lay-in stainless-steel sink.

a. Overall Dimensions: 22 inches left to right by 19 inches front to back.

b. Metal Thickness: 18 gage, with sound dampened underside.

c. Bowl:

1) Dimensions: 18 inches by 14 inches by 6 inches deep.

2) Drain: 3-1/2-inch grid.

d. Sink Faucet: SF-1.

e. Water Temperature Limiting Device: Required.

f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).

g. Disposer: Not required.

h. Dishwasher Air-Gap Fitting: Not required.

i. Hot-Water Dispenser: Not required.

2.09 SERVICE SINKS

A. Service Sinks, SS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.; Lakewell Service Sink.

b. Kohler Co.; Bannon K 6718.

c. Zurn Plumbing Products Group; Z5888.

2. Description: Trap-standard- and wall-mounting, enameled, cast-iron fixture with roll-rim with plain back and rim guard on front and sides.

a. Size: 22 by 18 inches.

b. Faucet: Sink SF-2.

c. Drain: Grid with NPS 3 outlet.

d. Trap Standard: NPS 3 enameled, cast iron with cleanout and floor flange.

e. Fixture Support: Required.

2.10 **SINK FAUCETS**

A. Sink Faucets, SF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.

b. Chicago Faucets; No. 895-317.

c. Delta Faucet Company; Model 27C4842.

d. Kohler Co.; K7305-5A.

e. Moen Commercial.

f. Speakman Company; SC-3085.

g. T & S Brass and Bronze Works, Inc.

h. Zurn Plumbing Products Group; Z812A4-140.

2. Description: Sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.

b. Finish: Polished chrome plate.

c. Mixing Valve: Two handle.

d. Centers: 4 inches.

e. Mounting: Deck.

f. Handle(s): Wrist blade, 4 inches.

g. Operation: Noncompression, manual.

h. Inlet(s): NPS 1/2.

i. Spout Type: 70 to 120-degree restricted gooseneck.

j. Spout Outlet:

1) Aerator.

k. Maximum Flow Rate:

1) 1.5 gpm.

B. Sink Faucets, SF-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.

b. Chicago Faucets; Model 305-VBCP.

c. Delta Faucet Company; Model 28C2083.

d. Kohler Co.

e. Moen Commercial.

f. Speakman Company; SC5821-PC-LEV-5H-WH.

g. T & S Brass and Bronze Works, Inc.

h. Zurn Plumbing Products Group.

2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.

a. Body Material: Commercial, solid brass.

b. Finish: Polished chrome plate.

c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.

d. Mixing Valve: Two handle.

e. Centers: 8 inches.

f. Mounting: Back/wall.

g. Handle(s): Lever.

h. Inlet(s): NPS 1/2.

i. Spout Type: Rigid, solid brass with pail hook.

j. Spout Outlet: Hose thread.

k. Vacuum Breaker: Required.

l. Operation: Noncompression, manual.

2.11 FIXTURE SUPPLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft; a Masco Company.

2. McGuire Mfg. Co., Inc.

3. Any of the approved plumbing fixture manufacturers.

B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers (PSG-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Engineered Brass Co.

b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.

c. McGuire Manufacturing Co., Inc.

d. Oatey; Dearborn Safety Series.

e. Plumberex Specialty Products Inc.

f. TCI Products; SG-200BV.

g. TRUEBRO, Inc.

h. Zurn Plumbing Products Group; Z8946-3-NT.

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.

2.13 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports:

1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include:

a. Single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement.

b. Faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture.

c. Cast iron nipple and coupling kit.

d. Additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: For wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Sink Supports:

1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.

a. Type I, sink carrier with exposed arms and tie rods.

b. Type II, sink carrier with hanger plate, bear studs, and tie rod.

c. Type III, sink carrier with hanger plate and exposed arms.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

2. Use carrier supports without waste fitting for fixtures with tubular waste piping.

3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install wall-mounting urinals with PVC-DWV piping from urinal outlet to first change in piping direction.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.

J. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section “Domestic Water Piping Specialties.”

K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

1. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.

L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

M. Install toilet seats on water closets.

N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.

R. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

S. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Adjust flow at laboratory faucets having serrated nozzles to prevent splashing.

D. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 **PROTECTION**

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 1
1.05 CLOSEOUT SUBMITTALS 1
1.06 QUALITY ASSURANCE 2
PART 2 PRODUCTS 2
2.01 PRESSURE (ELECTRIC) WATER COOLERS 2
2.02 FIXTURE SUPPORTS 3
PART 3 EXECUTION 3
3.01 EXAMINATION 3
3.02 APPLICATIONS 3
3.03 INSTALLATION 4
3.04 CONNECTIONS 4
3.05 FIELD QUALITY CONTROL 4
3.06 ADJUSTING 4
3.07 CLEANING 4

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. TDS: Total dissolved solids.

H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.03 ACTION SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities for fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

E. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 PRODUCTS

2.01 **PRESSURE (ELECTRIC) WATER COOLERS**

A. Water Coolers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Oasis Corporation, Model: 507045FVF (Base Bid).
    b. Haws Corporation.
    c. Murdock Manufacturing; A Member of Morris Group International.
    d. Elkay Manufacturing Co.
2. Description: Accessible, AHRI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult and child mounting height, with bottle filling station.
    a. Cabinet: Single, all stainless steel.
    b. Bubbler: One, flexible or elastomeric overmolded, with adjustable stream regulator, located on each cabinet deck.
    c. Control: push button.
    d. Supply: NPS 3/8 with isolation valve.
    e. Filter: Complying with NSF/ANSI standards 42 and 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
        1) Oasis Versa Filter III (Base Bid).
    f. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
    g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.

2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.

h. Bottle Filling Station: Recessed design constructed of Type 300 series stainless steel and ABS plastic. Include:

1) Electronic sensor for no-touch activation.

2) Automatic 20-second shut-off timer.

3) 1.1 gpm flow rate

4) Anti-microbial protected plastic components.

i. Support: Refer to "Fixture Supports" Article.

2.02 **FIXTURE SUPPORTS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **APPLICATIONS**

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.03 **INSTALLATION**

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.04 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **FIELD QUALITY CONTROL**

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.

2. Report test results in writing.

3.06 **ADJUSTING**

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.07 **CLEANING**

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 ACTION SUBMITTALS 1
1.04 QUALITY ASSURANCE 1
1.05 ENVIRONMENTAL REQUIREMENTS 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 FAN SHAFTS 2
2.03 FAN POWER TRANSMISSION 2
2.04 SHEAVES 2
2.05 V-BELT FAN DRIVES 3
2.06 FAN DRIVE, SHAFT, AND COUPLING GUARDS 3
2.07 BELT DRIVE GUARDS 3
2.08 V-BELTS 3
2.09 V-BELT DRIVE MOTOR BASES 4
2.10 FLEXIBLE COUPLINGS (DIRECT DRIVE) 4
2.11 MOTOR REQUIREMENTS 4
2.12 FAN BEARINGS 4
2.13 IDENTIFICATION 4
2.14 ACCESSORIES 4
2.15 AIR INTAKE PROTECTION SYSTEM 4
PART 3 EXECUTION 5
3.01 INSTALLATION 5

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 SUMMARY

A. This Section includes common requirements for fans and air moving equipment.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fan bearings.
2. V-belt fan drives.
3. Direct drive couplings.

1.04 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. Fan Performance Data: AMCA Standard 210.

C. Sound Power Level Ratings:

1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.

2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.05 **ENVIRONMENTAL REQUIREMENTS**

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 **FAN SHAFTS**

A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.03 **FAN POWER TRANSMISSION**

A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.

B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.

C. Base horsepower rating of drive on minimum pitch diameter of small sheave.

D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.

E. Adjust belt tension in accordance with the manufacturer's recommendations.

F. Perform alignment and final belt tensioning in the presence of the Architect.

2.04 **SHEAVES**

A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.

B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.

C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.

D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.

E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.

F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.05 V-BELT FAN DRIVES

A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.

B. Manufacturers:

1. Emerson Power Transmission; Browning.
2. Rockwell Automation; Dodge.
3. T.B. Wood’s Incorporated.

2.06 FAN DRIVE, SHAFT, AND COUPLING GUARDS

A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.

B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.

C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.

D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

E. Centrifugal exhaust fans shall be provided with shaft seals.

2.07 BELT DRIVE GUARDS

A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.

B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.08 V-BELTS

A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.

B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.

C. Manufacturers:

1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.09 V-BELT DRIVE MOTOR BASES

A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.

B. Provide for adjustment of both belt tension and alignment.

2.10 FLEXIBLE COUPLINGS (DIRECT DRIVE)

A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.

B. Manufacturer:

1. Falk Corporation (The).

2.11 MOTOR REQUIREMENTS

A. Furnish motors in accordance with Division 20 Section "Motors."

2.12 FAN BEARINGS

A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L_{10} minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.

1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L_{10} life requirements.

2.13 IDENTIFICATION

A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.14 ACCESSORIES

A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

2.15 AIR INTAKE PROTECTION SYSTEM

A. Provide custom heavy duty commercial grade air intake protection system including mesh filter fabric, fasteners, and installation on equipment.

B. Mesh fabric constructed with one layer of black PVC-coated polyester high-abrasion media, encased in sewn vinyl edge with single or double stitching and attached via stainless steel grommets. Media shall meet NFPA-701 Flame Resistance.

C. Filter shall have less than 0.05 inch wg initial resistance to air flow, depending on filter media and number of layers required.

D. Filter media shall be heat stabilized, shall not shed fibers, absorb moisture or promote bacterial growth.

E. Inherent electrostatic charge of woven polypropylene (BHC) media shall deliver higher particle arrestance efficiency and enhanced ability to capture and hold smaller particles.

F. Customizable to meet equipment air intake, or ventilation inlet and outlet configuration including those requiring pipe and electrical cut-outs, special shapes, and skirting where grommet attachment to the metal enclosure is not possible. Hook and loop, or magnets shall be added to completely seal air bypass.

G. Suppliers:

1. Permatron Corporation; PreVent System Filter Screen (800-882-8012)
2. Air Solution Company; Cottonwood Filter Screens (800-819-2869)
3. Aero Filter, Inc. (248-837-4100)

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.

B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.

C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 ACTION SUBMITTALS 2
1.05 QUALITY ASSURANCE 2
1.06 DELIVERY, STORAGE, AND HANDLING 2
PART 2 PRODUCTS 2
2.01 VALVES, GENERAL 2
2.02 BRONZE BALL VALVES 3
2.03 GENERAL SERVICE BUTTERFLY VALVES 4
2.04 BRONZE CHECK VALVES 4
2.05 IRON SWING CHECK VALVES 5
2.06 BRONZE OR STAINLESS STEEL LIFT CHECK VALVES 6
2.07 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES 6
2.08 BRONZE GLOBE VALVES 7
2.09 CAST-IRON GLOBE VALVES 7
2.10 BRONZE ANGLE VALVES 7
2.11 CAST-IRON ANGLE VALVES 8
2.12 DRAIN VALVES 8
2.13 CHAINWHEEL ACTUATORS 8
PART 3 EXECUTION 8
3.01 EXAMINATION 8
3.02 VALVE INSTALLATION 9
3.03 JOINT CONSTRUCTION 9
3.04 ADJUSTING 9

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section "Mechanical Identification" for valve tags and charts.
2. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
3. Division 22 Section “General-Duty Valves for Plumbing” for plumbing valves.
4. Division 23 Section "Temperature Controls" for control valves and actuators.

1.02 SUMMARY

A. This Section includes valves for general HVAC applications. Refer to piping Sections for specialty valve applications.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. NRS: Nonrising stem.

5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.04 **ACTION SUBMITTALS**

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 **QUALITY ASSURANCE**

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.06 **DELIVERY, STORAGE, AND HANDLING**

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 **VALVES, GENERAL**

A. Isolation valves are scheduled on the Drawings. For other general HVAC valve applications, use the following:

1. Throttling Service: Angle, ball, butterfly, or globe valves.
2. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. For valves not indicated in the Application Schedules, select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Systems: Valve ends may be grooved. Do not use for steam or steam condensate piping.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

G. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

H. Extended Valve Stems: On insulated valves.

I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

J. Valve Grooved Ends: AWWA C606.

K. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

L. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Series 70-140.
   b. Crane Co.; Crane Valves.
   c. Hammond Valve.
   d. Kitz Corporation; Kitz Valves.
   e. Milwaukee Valve Company; Model BA100S.

f. NIBCO INC.; Models S-580-70-66 or T-580-70-66.

g. Watts Water Technologies, Inc.

2.03 GENERAL SERVICE BUTTERFLY VALVES

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:

1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.

2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.

b. Bray International, Inc.

c. DeZurik.

d. Emerson Automation Solutions; Keystone.

e. Forum Energy Technologies; ABZ Valve.

f. Hammond Valve.

g. Milwaukee Valve Company.

h. NIBCO INC.; LD-2000-3/5.

i. Tyco Flow Control; Grinnell Flow Control.

j. Watts Water Technologies.

C. Grooved-End Butterfly Valves with EPDM-Encapsulated, or Electroless Nickel Coated Ductile-Iron Disc: Ductile-iron body with grooved or shouldered ends and polyamide coating inside and outside; Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12. Valve design shall provide bi-directional, bubble tight seal from full vacuum to 300 psig.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASC Engineered Solutions.

b. NIBCO INC.; Model GD-4765-3/5.

c. Victaulic Co. of America.

2.04 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 150, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 300 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.
b. Crane Co.; Crane Valves.
c. Crane Co.; Stockham Div.
d. Hammond Valve.
e. Milwaukee Valve Company; Model 515.
f. NIBCO INC.; Models S-433-B or T-433-B.
g. Watts Water Technologies.

2.05 **IRON SWING CHECK VALVES**

A. Iron Swing Check Valves, General: MSS SP-71.

B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company; Model F-2974.
   f. NIBCO INC.; Model F-918-B.
   g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company; Model F-2970.
   f. NIBCO INC.; Model F-968-B.
   g. Watts Water Technologies.

D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Co. of America; 716/716H/779.
   b. NIBCO, INC.; Model G-917-W.
   c. ASC Engineered Solutions.

2.06 BRONZE OR STAINLESS STEEL LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Bonomi USA, Inc.; Series S800.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO INC.; Model S-480-Y or T-480-Y.
    e. The Wm. Powell Company.
2. Description:
    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 250 psig.
    c. Body Design: Vertical flow.
    d. Body Material: ASTM B 584 Alloy C844 bronze; or ASTM A351-CF8M stainless steel.
    e. Ends: Threaded or Solder.
    f. Disc: PTFE, or TFE.

2.07 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. NIBCO INC.; Model W-910-B.
    b. Mueller Steam Specialty.
    c. Milwaukee Valve Company.
    d. Hammond Valve.

C. Class 250, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 400 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. NIBCO INC.; Model W-960-B.
    b. Mueller Steam Specialty.
    c. Milwaukee Valve Company.
    d. Hammond Valve.

D. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. NIBCO INC.; Model F-910-B.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

E. Class 250, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 400 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-960-B.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

2.08 BRONZE GLOBE VALVES

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 150, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 300 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.

b. Crane Co.; Crane Valves.

c. Hammond Valve.

d. Milwaukee Valve Company; Model 590.

e. NIBCO INC.; Models S-235-Y or T-235-Y.

f. Watts Water Technologies, Inc.

2.09 CAST-IRON GLOBE VALVES

A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.

b. Crane Co.; Crane Valves.

c. Crane Co.; Stockham Valves.

d. Hammond Valve.

e. Milwaukee Valve Company; Model F-2981.

f. NIBCO INC.; Model F-718-B.

g. Watts Water Technologies, Inc.

2.10 BRONZE ANGLE VALVES

A. Bronze Angle Valves, General: MSS SP-80, with silicon bronze stem, non-asbestos packing and malleable-iron handwheel.

B. Class 150, Bronze Angle Valves: ASTM B 62 bronze body with TFE disc, union-ring bonnet, threaded ends, and having 300-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valves.

b. Crane Co.; Stockham Valves.

c. Hammond Valve.

d. Milwaukee Valve Company; Model 595T.

e. NIBCO INC.; Model T-335-Y.

f. The Wm. Powell Company.

2.11 CAST-IRON ANGLE VALVES

A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.

B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-818-B.

b. Crane Co.; Stockham Valves.

c. Crane Co.; Crane Valves.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Bronze ball valve as specified in this Section.

2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.13 CHAINWHEEL ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.

2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.

2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 **VALVE INSTALLATION**

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Lift Check Valves: With stem upright and plumb.

3.03 **JOINT CONSTRUCTION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 **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.

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 2
1.04 INFORMATIONAL SUBMITTALS 3
1.05 CLOSEOUT SUBMITTALS 3
1.06 QUALITY ASSURANCE 3
1.07 PROJECT CONDITIONS 4
1.08 COORDINATION 4
1.09 WARRANTY 4
PART 2 PRODUCTS (NOT APPLICABLE) 4
PART 3 EXECUTION 4
3.01 EXAMINATION 5
3.02 PREPARATION 5
3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING 6
3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS 6
3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS 7
3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS 8
3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS 8
3.08 PROCEDURES FOR HYDRONIC SYSTEMS 9
3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS 9
3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS 10
3.11 PROCEDURES FOR HEAT EXCHANGERS 10
3.12 PROCEDURES FOR MOTORS 10
3.13 PROCEDURES FOR HEAT-TRANSFER COILS 10
3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS 10
3.15 PROCEDURES FOR COMMERCIAL KITCHEN HOODS 11
3.16 PROCEDURES FOR EXHAUST HOODS 11
3.17 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS 11
3.18 TOLERANCES 12
3.19 REPORTING 12
3.20 FINAL REPORT 12
3.21 INSPECTIONS 21
3.22 ADDITIONAL TESTS 22

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Common Work Results for HVAC.”

1.02 SUMMARY

A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:

1. Air Systems:

a. Constant-volume air systems.

b. Variable-air-volume systems.

2. Hydronic Piping Systems:

a. Constant-flow systems.

b. Variable-flow systems.

c. Primary-secondary systems.

3. HVAC equipment quantitative-performance settings.

4. Kitchen hood airflow balancing.

5. Exhaust hood airflow balancing.

6. Space pressurization testing and adjusting.

7. Verifying that automatic control devices are functioning properly.

8. Reporting results of activities and procedures specified in this Section.

B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.03 **DEFINITIONS**

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. AHJ: Authority having jurisdiction.

C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

F. NC: Noise criteria.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. RC: Room criteria.

I. Report Forms: Test data sheets for recording test data in logical order.

J. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

M. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

N. TAB: Testing, adjusting, and balancing.

O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

P. Test: A procedure to determine quantitative performance of systems or equipment.

Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 **INFORMATIONAL SUBMITTALS**

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

B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Sample Report Forms: Submit two sets of sample TAB report forms.

1.05 **CLOSEOUT SUBMITTALS**

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

B. Warranties specified in this Section.

1.06 **QUALITY ASSURANCE**

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. Approved Balancing Agencies.

1. The TAB firm selected shall be from the following list:

a. Airflow Testing Inc.; Lincoln Park, MI.

b. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.

c. Ener-Tech Testing; Holly, MI.

d. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.

e. International Test & Balance Inc.; Southfield, MI.

f. Quality Air Service; Portage, MI.

C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.

b. The Contract Documents examination report.

c. TAB plan.

d. Work schedule and Project-site access requirements.

e. Coordination and cooperation of trades and subcontractors.

f. Coordination of documentation and communication flow.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.

F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.07 **PROJECT CONDITIONS**

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

1.08 **COORDINATION**

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.

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

1.09 **WARRANTY**

A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

B. Examine system and equipment test reports.

C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

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

F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

G. Examine strainers for clean screens and proper perforations.

H. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

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

J. Examine system pumps to ensure absence of entrained air in the suction piping.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

M. 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.

3.02 **PREPARATION**

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.

C. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.

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. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.

G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

H. Verify that motor starters are equipped with properly sized thermal protection.

I. Check dampers for proper position to achieve desired airflow path.

J. Check for airflow blockages.

K. Check condensate drains for proper connections and functioning.

L. Check for proper sealing of air-handling unit components.

M. Check for proper sealing of air duct system.

3.05 **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 fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

5. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 **PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow.

a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record the final fan performance data.

3.07 **GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.

2. Check expansion tank liquid level.

3. Check makeup-water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation and set at indicated flow.

5. Set system controls so automatic valves are wide open to heat exchangers.

6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.08 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.

G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

H. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance variable-flow hydronic systems by following the “Proportional Balancing Procedure” in accordance with NEBB.

B. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Record inlet steam pressure.

E. Record settings of safety and relief valves.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Power factor.
6. Nameplate and measured voltage, each phase.
7. Nameplate and measured amperage, each phase.
8. Starter size.
9. Starter thermal-protection-element rating.
10. Fuse number and size.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Electric-Heating Coils: Measure the following data for each coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.15 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.

B. After balancing is complete, do the following:

1. Measure and record the static pressure at the hood exhaust-duct connection.
2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.

C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.

1. Check duct slopes as required.
2. Verify that duct access is installed as required.
3. Verify that point of termination is as required.
4. Verify that duct air velocity is within the range required.
5. Verify that duct is within a fire-rated enclosure.

D. Report deficiencies.

3.16 PROCEDURES FOR EXHAUST HOODS

A. Measure, adjust, and record the airflow of each exhaust hood. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, explain why, in the report, and explain the test method used.

B. After balancing is complete, do the following:

1. Measure and record the static pressure at the hood exhaust-duct connection.
2. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to achieve optimum results.

3.17 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.

C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.

1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.

2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.

3. Test room pressurization first, then zones, and finish with building pressurization.

D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.

E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.

1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.

2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.

3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.

F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.

G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.18 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Air handling equipment and outlets: Plus or minus 5 percent.

a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.

2. Heating-Water Flow Rate: 0 to minus 10 percent.

3.19 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.20 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB firm who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.
   13. Notes to explain why certain final data in the body of reports varies from indicated values.
   14. Test conditions for fans and pump performance forms including the following:
      a. Settings for outside-, return-, and exhaust-air dampers.
      b. Conditions of filters.
      c. Cooling coil, wet- and dry-bulb conditions.
      d. Face and bypass damper settings at coils.
      e. Fan drive settings including settings and percentage of maximum pitch diameter.
      f. Inlet vane settings for variable-air-volume systems.
      g. Settings for supply-air, static-pressure controller.
      h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outside, supply, return, and exhaust airflows.
   2. Water flow rates.
   3. Terminal units.
   4. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data: Include the following:
      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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
      j. Number of belts, make, and size.
      k. Number of filters, type, and size.
   2. Motor Data:
      a. Make and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
      g. Power factor efficiency.
   3. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm.
      b. Total system static pressure in inches wg.
      c. Fan rpm.
      d. Discharge static pressure in inches wg.
      e. Filter static-pressure differential in inches wg.
      f. Preheat coil static-pressure differential in inches wg.
      g. Cooling coil static-pressure differential in inches wg.
      h. Heating coil static-pressure differential in inches wg.
      i. Outside airflow in cfm.
      j. Return airflow in cfm.

k. Outside-air damper position.

l. Return-air damper position.

m. Vortex damper position.

G. 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. Outside-air, wet- and dry-bulb temperatures in deg F.

e. Return-air, wet- and dry-bulb temperatures in deg F.

f. Entering-air, wet- and dry-bulb temperatures in deg F.

g. Leaving-air, wet- and dry-bulb temperatures in deg F.

h. Water flow rate in gpm.

i. Water pressure differential in feet of head or psig.

j. Entering-water temperature in deg F.

k. Leaving-water temperature in deg F.

H. 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 Btuh.

h. Ignition type.

i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Sheave dimensions, center-to-center, 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 Btuh.
i. High-fire fuel input in Btuh.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btuh.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btuh.

I. 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 Btuh.
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 Btuh.
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.

J. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

K. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.

g. Indicated 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.

L. Air-Terminal-Device Reports:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device 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.

M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Unit make and model number.
d. Compressor make.
e. Compressor model and serial numbers.
2. Test Data (Indicated and Actual Values):
a. Inlet-duct static pressure in inches wg.
b. Outlet-duct static pressure in inches wg.
c. Entering-air, dry-bulb temperature in deg F.
d. Leaving-air, dry-bulb temperature in deg F.

e. Condenser entering-water temperature in deg F.
f. Condenser leaving-water temperature in deg F.
g. Condenser-water temperature differential in deg F.
h. Condenser entering-water pressure in feet of head or psig.
i. Condenser leaving-water pressure in feet of head or psig.
j. Condenser-water pressure differential in feet of head or psig.
k. Control settings.
l. Voltage at each connection.
m. Amperage for each phase.
n. Kilowatt input.
o. Crankcase heater kilowatt.
p. Number of fans.
q. Condenser fan rpm.
r. Condenser fan airflow rate in cfm.
s. Condenser fan motor make, frame size, rpm, and horsepower.
t. Condenser fan motor voltage at each connection.
u. Condenser fan motor amperage for each phase.

N. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Ratings.
2. Steam Test Data (Indicated and Actual Values):
a. Inlet pressure in psig.
b. Condensate flow rate in lb/h.
3. Primary Water Test Data (Indicated and Actual Values):
a. Entering-water temperature in deg F.
b. Leaving-water temperature in deg F.
c. Entering-water pressure in feet of head or psig.
d. Water pressure differential in feet of head or psig.
e. Water flow rate in gpm.
4. Secondary Water Test Data (Indicated and Actual Values):
a. Entering-water temperature in deg F.
b. Leaving-water temperature in deg F.

c. Entering-water pressure in feet of head or psig.

d. Water pressure differential in feet of head or psig.

e. Water flow rate in gpm.

O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.

b. Location.

c. Service.

d. Make and size.

e. Model and serial numbers.

f. Water flow rate in gpm.

g. Water pressure differential in feet of head or psig.

h. Required net positive suction head in feet of head or psig.

i. Pump rpm.

j. Impeller diameter in inches.

k. Motor make and frame size.

l. Motor horsepower and rpm.

m. Voltage at each connection.

n. Amperage for each phase.

o. Full-load amperage and service factor.

p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.

b. Pump shutoff pressure in feet of head or psig.

c. Actual impeller size in inches.

d. Full-open flow rate in gpm.

e. Full-open pressure in feet of head or psig.

f. Final discharge pressure in feet of head or psig.

g. Final suction pressure in feet of head or psig.

h. Final total pressure in feet of head or psig.

i. Final water flow rate in gpm.

j. Voltage at each connection.

k. Amperage for each phase.

P. Air-to-Air Heat-Recovery Unit Reports:

1. Unit Data:

a. Unit identification.

b. Location.

c. Service.

d. Make and type.

e. Model and serial numbers.

2. Motor Data:

a. Make and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full load amperage and service factor.

e. Sheave make, size in inches, and bore.

f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. If fans are an integral part of the unit, include the following for each fan:

a. Make and type.

b. Arrangement and size.

c. Sheave make, size in inches, and bore.

d. Sheave dimensions, center-to-center, and amount of adjustments in inches.

4. Test Data (Indicated and Actual Values):

a. Total exhaust airflow rate in cfm.

b. Purge exhaust airflow rate in cfm.

c. Outside airflow rate in cfm.

d. Total exhaust fan static pressure in inches wg.

e. Total outside-air fan static pressure in inches wg.

f. Pressure drop on each side of recovery wheel in inches wg.

g. Exhaust air temperature entering in deg F.

h. Exhaust air temperature leaving in deg F.

i. Outside-air temperature entering in deg F.

j. Outside-air temperature leaving in deg F.

k. Calculate sensible and total heat capacity of each airstream in MBh.

3.21 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.

2. Randomly check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.

b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.

c. Measure space pressure of at least 10 percent of locations.

d. Verify that balancing devices are marked with final balance position.

e. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.22 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 0933 - TEMPERATURE CONTROLS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 2
1.03 DEFINITIONS 2
1.04 SYSTEM DESCRIPTION 2
1.05 SEQUENCE OF OPERATION 2
1.06 SUBMITTALS 2
1.07 REFERENCES 5
1.08 QUALITY ASSURANCE 6
1.09 DELIVERY, STORAGE, AND HANDLING 6
1.10 COORDINATION 6
1.11 WARRANTY 7
1.12 POSTED OPERATING INSTRUCTIONS 7
1.13 SPECIAL TOOLS 7
1.14 PROTECTION OF PROPRIETARY INFORMATION 7

PART 2 PRODUCTS 7
2.01 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS) 7
2.02 BAS BUILDING NETWORK SUPERVISORY CONTROLLER (EXISTING) 7
2.03 DDC CONTROLLER SOFTWARE 8
2.04 DDC AIR TERMINAL UNIT CONTROLLERS 11
2.05 DDC INPUT/OUTPUT SENSORS 12
2.06 DDC DATA COMMUNICATIONS NETWORK 16
2.07 AIRFLOW MEASURING PROBES – DUCT MOUNTED 16
2.08 CONTROL AND INSTRUMENTATION TUBING 17
2.09 CONTROL VALVES AND VALVE OPERATORS 17
2.10 DAMPERS - AUTOMATED 19
2.11 DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED 20
2.12 DAMPER OPERATORS - ELECTRIC 20
2.13 DIFFERENTIAL PRESSURE SWITCHES 21
2.14 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK 21
2.15 LIMIT SWITCHES 21
2.16 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS 22
2.17 REFERENCE PROBE - DUCT STATIC PRESSURE 22
2.18 REFERENCE PROBE - INDOOR STATIC PRESSURE 22
2.19 THERMOSTATS – ELECTRONIC & ELECTRIC 22

PART 3 EXECUTION 23
3.01 INSTALLATION - CONTROL SYSTEMS 23
3.02 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS 24
3.03 IDENTIFICATION AND MARKING 24
3.04 GRAPHIC DISPLAY GENERATION 25
3.05 OWNER INSTRUCTION AND TRAINING 26
3.06 CALIBRATION AND START-UP 26
3.07 ACCEPTANCE PROCEDURE 26

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”

2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 **SUMMARY**

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.03 **DEFINITIONS**

A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012.

B. BAS: Building Automation System

C. CAD: Computer Aided Design.

D. DDC: Direct-digital controls.

E. TC: Temperature Control.

1.04 **SYSTEM DESCRIPTION**

A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc., and all associated control wiring and raceway systems.

B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Supervisory Controller or at the remote operator workstation (when applicable for project).

C. Electric thermostats, control valves, dampers, operators, control wiring, etc.

D. Indicating devices, electric and electronic control accessories, and other control system devices.

1.05 **SEQUENCE OF OPERATION**

A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.06 **SUBMITTALS**

A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.

B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control.

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

E. Shop Drawings:

1. Shop drawings shall be done on CAD. Minimum size 11” x 17”.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.

3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
5. Written sequence of operation for each controlled system.
6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
8. Complete bill of materials to identify and quantify all control components.
9. Overall system schematic showing communication trunk cabling from Building Network Supervisory Controller(s) to BAS field level controllers including component locations and wire termination details.
10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote control component termination details shall be provided.
11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.

F. Graphic Displays: One month after TC Shop Drawing submittal, TC Contractor shall submit graphical display backgrounds for preliminary Engineer review. Concept for each floor plan, each system, each terminal unit template. Engineer understands that final representation of graphics may not be available until BAS database is established during course of construction. Thorough graphics review will be conducted by Engineer as part of the TC/BAS acceptance procedure.

G. Design Data: Provide indicated component selection and sizing criteria for the following component categories:

1. Control valves:
    a. Component tag.
    b. Equipment served/function.
    c. Media type.
    d. Design flow rate (GPM).
    e. Design pressure drop (psi), where applicable.
    f. Calculated valve Cv, where applicable.
    g. Selected valve Cv, where applicable.
    h. Resultant pressure drop (psi) with selected valve.
    i. Valve size.
    j. Line size to valve connection (excluding reducers).
    k. Type (ball, butterfly, globe, etc.).
    l. Configuration (2-way, 3-way mixing, 3-way diverting).
    m. Normal position (normally open, normally closed, floating).
    n. Actuator spring range (where applicable).
    o. Actuator power requirement.
    p. Valve shut-off rating (psi)
    q. Valve body pressure/temperature rating.

r. Valve manufacturer/model number.

s. Actuator manufacturer/model number.

2. Dampers:

a. Component tag.

b. Equipment served/function.

c. Overall damper size (inch width x inch height).

d. Quantity of damper sections with respective size(s):

e. Material and gauge of thickness.

f. Mounting orientation (horizontal or vertical).

g. Blade configuration (parallel or opposed)

h. Pressure drop (in. w.g.).

i. Shut-off rating/differential pressure rating (in. w.g.).

j. Leakage rating (CFM/sq. ft. at 4 in. w.g.).

k. Normal position (normally open, normally closed, floating).

l. Actuator spring range (where applicable).

m. Actuator power requirement.

n. Actuator torque requirement.

o. Actuator quantity.

p. Damper manufacturer/model number.

q. Actuator manufacturer/model number.

3. Flow measuring probes - Air:

a. Component tag.

b. Equipment served/function.

c. Duct dimension (inch width x inch height) if applicable.

d. Fan inlet diameter (inch) if applicable)

e. Probe quantity.

f. Probe length (inch).

g. Flow rate (CFM).

h. Flow velocity (FPM).

i. Probe manufacturer/model number.

j. Transmitter manufacturer/model number.

4. Flow measuring meters - Water:

a. Component tag.

b. Equipment served/function.

c. Pipe size/inside diameter (inch)

d. Probe length.

e. Flow rate (GPM).

f. Flow velocity (FPS).

g. Probe manufacturer/model number.

h. Transmitter manufacturer/model number.

5. Flow measuring stations - Air:

a. Component tag.

b. Equipment served/function.

c. Duct dimension (inch width x inch height).

d. Station dimension (inch width x inch height).

e. Flow rate (CFM).

f. Flow velocity (FPM).

g. Pressure drop (in. w.g.).

h. Station manufacturer/model number.

i. Transmitter manufacturer/model number.

H. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.

I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

J. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.

K. Project Record Documents: Include the following:

1. Revise Shop Drawings to reflect actual installation and operating sequences.

2. Record actual locations of control components, including control units, thermostats, and sensors.

3. Submit three (3) the electronic files for all as-built shop drawings in pdf format on USB Flash Drives.

L. Software and Firmware Operational Documentation: Include the following:

1. DDC controller keypad operating instructions and DDC controller override features, where applicable.

2. Device address list.

3. Program Software Backup: On a magnetic media or compact disc, complete with data files.

M. Maintenance Manuals: Include the following:

1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.

2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.

3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

4. Calibration records and list of set points.

1.07 **REFERENCES**

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.

C. ANSI/ASTM B32 - Solder Metal.

D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

F. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.

G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

H. ASTM E1 - Specification for ASTM Thermometers.

I. MMC – Michigan Mechanical Code, version applicable for project.

J. NEMA DC 3 - Low-Voltage Room Thermostats.

K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.08 **QUALITY ASSURANCE**

A. Installer Qualifications: An experienced installer who is an authorized representative and certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with all applicable code requirements for project.

1.09 **DELIVERY, STORAGE, AND HANDLING**

A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 **COORDINATION**

A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.

B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.

D. Ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.

F. Coordinate equipment with Division 26 Section "Lighting Controls" to achieve compatibility with equipment that interfaces with that system.

G. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

H. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.

I. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 **WARRANTY**

A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.

B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.

C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make one eight-hour service call each month. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 **POSTED OPERATING INSTRUCTIONS**

A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 **SPECIAL TOOLS**

A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, excluding PC laptop.

1.14 **PROTECTION OF PROPRIETARY INFORMATION**

A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 PRODUCTS

2.01 **DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)**

A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly connected to HVAC equipment sensors and actuators. An existing data communication network shall allow data exchange between the BAS field level DDC controllers and the existing Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building through server application software.

B. Approved Manufacturer – System / Approved Installer (Locations) as listed:

1. Schneider Corp. / Mechanical Controls & Maintenance, Inc. aka MCMI (Sterling Heights, MI).

2.02 **BAS BUILDING NETWORK SUPERVISORY CONTROLLER (EXISTING)**

A. The Building Network Supervisory Controller is existing and shall be utilized to provide the communication interface between the Owner’s Ethernet and the field control devices.

B. Provide updated and upgraded software and hardwire to support the additional controller addresses in this project.

2.03 **DDC CONTROLLER SOFTWARE**

A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.

B. Input/Output point processing shall include the following:

1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.

2. Assignment of proper engineering units and status condition identifiers to all points.

3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC Input/Output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.

C. Command control software shall manage the receipt of commands from control panels, portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.

1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.

2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.

3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.

4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.

D. Provide self-test procedure. Notify remote Operator Workstation (when applicable for project) for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.

E. Alarm Processing

1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.

2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.

3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm

shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.

4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.

5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization

1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.

2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.

3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration

1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote, or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.

2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.

3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.

4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:

   a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.

   b. Logic: OR, AND, compare, negate.

c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.

d. Data Manipulation: Store, file and set.

e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.

H. Building Automation System program applications (as required for controllers)

1. Time of day scheduling: Allow the creation and maintenance of operating schedules for selected points based on time of day and holiday scheduling. At least two independent start and stop times per day for each system shall be allowed. Each point shall be allowed to have a unique time program, or points shall be able to be grouped and assigned to a common time program. Both digital and analog output points shall be able to be assigned to a time program. This software shall work in conjunction with the time of day scheduler software at the remote Operator Workstation (when applicable for project). This program shall also work in conjunction with the optimum start and optimum stop application software.

2. Optimum Start: Start equipment based on outdoor temperature, space temperature, and system response to minimize energy usage and to assure that comfort conditions are reached exactly at scheduled occupancy time (occupancy schedules are defined under "Time Of Day Scheduling"). This program shall operate in both the heating and cooling cycles. An adaptive algorithm shall be employed which automatically adjusts the start time according to previous performance and shall automatically assign longer lead times for weekend and holiday shutdowns.

3. Enthalpy Optimization: Using standard psychrometric calculations, automatically determine which air source, outdoor air or return air, presents the least total heat load, and automatically adjust mixed air damper position. When outside enthalpy exceeds return air enthalpy, the outside air damper shall go to its minimum position. Typically, the outside air damper must be in its minimum position before the cooling coil valve is allowed to open.

4. Duty Cycle: Periodically cycle electrical equipment to reduce energy consumption and/or energy demand. Each load shall be assigned a cycle interval and an off period. A load leveling algorithm shall be utilized to assure that cycle periods do not coincide.

5. Demand Limiting: Distributed power demand program shall be based on a sliding window instantaneous demand algorithm. The DDC controller(s) connected to the demand meter shall calculate the demand, forecast the demand trend, compare it to established demand limits, and initiate load shedding action or reestablishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last. Restoration cycle shall add the most important loads first. DDC controllers on the network shall each have a four-tier shed table for assignment of sheddable loads. When a request is issued to the network to shed a specific number of kilowatts, each DDC controller shall shed Tier 1 loads, Tier 2 loads, etc. until the shed requirement is met. The program shall have the capability to sum the readings from multiple meters connected to multiple DDC controllers on the network, and to shed various loads from multiple DDC controllers on the network.

6. Optimum Start: Warm-Up or Cool-down as required with air terminal units at their maximum flow settings. When the desired space temperature is reached, as determined by feedback from space temperature sensor(s), provide occupancy operation. When occupancy time is reached, the outside air dampers shall be controlled by the normal occupied mode control sequence. During the warm-up cycle, the outside air damper shall be set at the position

which minimizes outside air intake while preventing over/under pressurizing of ductwork. This program shall work in conjunction with the time scheduling program and/or the optimum start program as required.

7. Night Cycle: Cycle HVAC equipment on and off as required to maintain an operator selectable unoccupied space temperature. During the equipment "on" time, the outside air damper shall be maintained in an adjustable position which minimizes outside air intake while preventing over/under pressurization of ductwork. The equipment shall be cycled such that energy reduction during unoccupied periods is uniform.

8. Night Purge: Night Purge program shall apply to cooling cycle only. Night Purge shall introduce 100% outdoor air any time the outdoor air is above 50°F, the space temperature is above 75°F, the outdoor air temperature is below space temperature and the outdoor air dew point is less than 60°F. Purging shall stop when outdoor air is below 50°F, or space temperature is below 75°F, or outdoor temperature is less than 5°F cooler than space temperature, or outdoor air dew point is greater than 60°F.

9. Reset Optimization: Adjust equipment discharge setpoints based on one of the following criteria:

   a. By sensing the worst case requirements (E.g., the zone requiring the most heating or cooling and providing only the minimum energy required to meet the load.

   b. Adjusting the setpoint in direct proportion to another sensed variable (E.g., reset supply water temperature based on outside temperature).

2.04 DDC AIR TERMINAL UNIT CONTROLLERS

A. Microprocessor based controllers capable of stand-alone operation for control of pressure independent air terminal units. Controllers shall be networked together and connected to the building's BAS/DDC network.

B. Controllers shall have separate adjustable minimum and maximum airflow setpoints. Controllers shall work in conjunction with the air handling unit's DDC panel to provide the sequence of operation as indicated on the drawings. Setpoints shall be adjustable through the portable programmer terminal.

C. Provide electronic type air terminal unit damper operators compatible with the controller and the air terminal units provided.

D. Each controller shall have an internal differential pressure transducer capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Velocity sensor shall be furnished by air terminal unit manufacturer.

E. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable

F. TC contractor shall provide 24 VAC power requirements including transformers.

G. If coordinated with mechanical contractor. Controllers and damper operators shall be furnished to the air terminal unit manufacturer for factory mounting by the air terminal unit manufacturer; otherwise, controls shall be field installed.

H. Room temperature sensors for the DDC air terminal unit controllers:

1. Sensing Element: Thermistor or resistance temperature detector (RTD) type. Accuracy shall be+/- 0.5 degrees F over the range of 55 degrees F to 95 degrees F, including calibration error, repeatability, hysteresis, and yearly drift.

2. Cover: with tamper-proof fasteners.

3. Provide with exposed setpoint adjustment dial and exposed temperature reading.

4. Provide with exposed override switch to allow an occupant to reset the space to occupied control during the unoccupied cycle for a predetermined time period.
5. Provide with portable operator unit plug-in port.

2.05 **DDC INPUT/OUTPUT SENSORS**

A. Air Static/Differential Pressure Transmitters:

1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
2. Safe overpressure rating shall be minimum 5 times the range.
3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
4. Accuracy: +/- 0.5% of full scale including calibration error, repeatability, hysteresis, and yearly drift.
5. Manufacturers:
   a. Air Monitor.
   b. Belimo.
   c. Dwyer.
   d. Modus.
   e. Setra.

B. Carbon Dioxide Sensors:

1. Carbon dioxide sensing cell shall consist of a nondispersive infrared carbon dioxide gas cell that uses a pulsed source and has no free air optical path. Output shall be linearized 4-20 mA with the 24 VDC input. In addition, the unit shall be capable of providing SPDT switching of an external low voltage circuit at an adjustable setpoint. The unit shall be specifically designed for the wall or duct application specified. Return air aspiration boxes shall be designed by and approved by the manufacturer. Unit shall have single point setpoint and span adjustment. The unit shall have no moving parts.
2. Power for the sensor shall be extended from a transformer or adaptor installed adjacent to the DDC controller enclosure panel, and shall be run parallel to the 4-20 mA signal cable.
3. Minimum sensing range shall be 0-2,000ppm.
4. Overall Accuracy shall be 3% of full scale including calibration error, repeatability, hysteresis and yearly drift.
5. Minimum calibration interval shall be 5 years.
6. Contractor shall provide all necessary equipment and test gas for calibration and shall calibrate all CO_2 sensors in accordance with the manufacturer's recommendations.
7. Manufacturer:
   a. Specified BAS product where available that meets the requirements herein.
   b. Belimo.
   c. TelAire.
   d. Vaisala.
   e. Veris.

C. Current Switches:

1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. For Electronically Commutated Motor (ECM) applications: Current switch shall be rated for ECM operation with amperage trip setting higher than trickle/idle/standby amperage with ECM off and amperage trip setting lower than minimum speed setting. Verify minimum amperage expectation for equipment with equipment suppliers to select appropriate current switch from list of approved manufacturers as their minimum trip settings vary from 0.15A to 0.5A.
3. For induction motor applications (as applicable): Current switch shall have adjustable trip setting to accommodate VFC minimum speed settings, to detect fan belt loss, or to detect pump coupling detachment. Set trip setting at approximately 90% of normal motor operating amperage.
4. Manufacturers:
    a. ACI.
    b. Senva.
    c. Veris Industries.

D. Differential Pressure Transmitters:
1. Transmitters used for measuring differential pressure only:
    a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
    b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
    c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
    d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
    e. Span and zero shall be individually adjustable.
    f. With LCD Display.
    g. Manufacturers:
        1) Belimo.
        2) Dwyer.
        3) Setra.
        4) Veris Industries.
2. Transmitters used for measuring differential pressure only:
    a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches W.C. (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.

b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.

c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.

d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.

e. Span and zero shall be individually adjustable.

f. Manufacturers:

1) Tobar.

2) ITT Barton.

3) Yokogawa.

4) Taylor.

5) Rosemount.

6) Honeywell Industrial Division.

7) Foxboro.

8) SOR.

3. Indication Gauges for Differential Pressure Transmitters:

a. Each transmitter shall come with an indicating gauge which reads in gpm or inches of water (whichever is the final value desired). The gauge may be either an analog differential pressure gauge piped in parallel to the transmitter or a digital display wired directly to the output of the transmitter.

b. The analog pressure gauge shall be selected and calibrated for the same span as the transmitter it serves.

c. The accuracy, including linearity, hysteresis and repeatability, of the gauge for measuring differential pressure shall be better than 3% of the span stated above throughout its span. Calibration data shall be included on an embossed tag attached to each gauge.

d. The gauge shall not be damaged by pressures of up to 500 psig on either side of the gauge and all wetted parts shall be essentially inert in the presence of up to 40% concentration of ethylene or propylene glycol in water.

e. Scale shall be a minimum of 4.5" long. Furnish and install two bleed fittings for each gauge and mounting brackets appropriate for the installation location.

4. Three Valve Manifold:

a. Provide a three-valve manifold for each transmitter. The manifold shall not be damaged by pressures of up to 500 psig and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene glycol in water.

b. The manifold shall be designed for direct mounting on the transmitter it serves and utilize quarter-turn valves to provide zeroing, blocking and normal service modes.

5. Installation by mechanical contractor: Only hard copper per schedule is allowed for piping.

E. Humidity Sensors:

1. Elements: Thin film or polymer capacitive type or bulk polymer resistance type with linear output, accurate within ± 2% RH throughout the range of 10-95% RH and drift to be less than +/-0.25%.
2. Humidity sensors shall be resistant to chlorine and other cleaning agents.
3. Room Sensors: With locking cover matching space temperature sensors used.
4. Duct Sensors: With duct probe and mounting plate.
5. Manufacturers:
    a. Specified BAS product where available that meets the requirements herein.
    b. Belimo.
    c. GE Industrial, Sensing (formerly General Eastern)
    d. Rotronic.
    e. Vaisala.
    f. Veris – HD/HO Series.

F. Outside Air Temperature/Humidity Combination Transmitters:

1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.
2. Temperature sensor: Refer to Temperature Sensors specifications. Range of operation shall be -25 degrees F to 125 degrees F.
3. Humidity sensor: Refer to Humidity Sensors specifications. Range of operation shall be 0-100% RH.
4. Manufacturer:
    a. Belimo.
    b. Vaisala.
    c. Veris.

G. Temperature Sensors:

1. Resistance temperature detectors (RTD) with 1000 ohm, thin-filmed platinum, nickel or Balco element having 0.000385 temperature coefficient meeting the input requirements of the DDC controller.
2. Thermally sensitive resistors (thermistor) shall be 10k-type, epoxy or glass coated, having NTC characteristic, meeting the input requirements of the DDC controller.
3. Initial calibration accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
4. Additional error such as repeatability, stability, tolerance, linearity and hysteresis shall not exceed an additional +/- 0.5 deg F additive (using RMS method) throughout the selected operating range for the application.
5. Temperature sensors shall be resistant to chlorine and other cleaning agents
6. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.
7. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.
8. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected

based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F

9. Room sensors shall have locking cover and a minimum span of 40 - 90°F.
10. Outside air temperature (only) sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.
11. Manufacturers:
    a. Specified BAS product where available that meets the requirements herein.
    b. ACI – except PT1000 averaging sensor.
    c. BAPI – Basys Series.
    d. Belimo.
    e. MAMAC
    f. Minco.
    g. TCS.

2.06 DDC DATA COMMUNICATIONS NETWORK

A. Data communication to large equipment controllers shall be by BACnet over IP where possible.

B. Where IP is not available or provided by 3rd party suppliers, data communication network with RS-485 BACnet MS/TP wiring shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.

C. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Supervisory Controller shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network though the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.

D. Data communications media shall be twisted pair wires.

E. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.

F. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.

G. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.

H. Error recovery and communication initialization routines shall be resident in each network connected device.

2.07 AIRFLOW MEASURING PROBES – DUCT MOUNTED

A. Duct airflow measuring probes shall contain multiple total and static pressure sensors located along the exterior surface of the probe, designed to compensate for non-axial or turbulent flow.

B. Thermal Dispersion type technology may be used in-lieu of static pressure measurement.

C. Probes shall be constructed of extruded aluminum. Probes shall be provided with mounting plate, gasket, and static and total pressure fittings. Probe and mounting hardware shall facilitate easy removal and reinstallation of the probes.

D. The number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes provided at a single location shall be interconnected external to the duct to produce an average signal.

E. For each airflow measurement location, the measured velocity pressure shall have accuracy within ± 2% of the full scale throughout the velocity range of 300-4000 fpm.

F. Each airflow measurement location shall be provided with an air volume gauge, dial and pointer type with diaphragm element. Black letters on white background, 4" diameter, with scale calibrated to permit direct reading of the airflow (in cfm) of the connected airflow measuring station. LCD readout with associated transmitter is acceptable.

G. Manufacturers:

1. Air Monitor Corporation.
2. Farr.
3. Ultratech Industries, Inc.
4. Brandt.
5. Tek-Air Systems, Inc.
6. Ramsey Ventures.
7. Ebtron.

2.08 CONTROL AND INSTRUMENTATION TUBING

A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.

1. Fittings: ANSI/ASME B16.22, wrought copper.
2. Joints: ANSI/ASTM B32, 95-5 tin antimony.

B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.

1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
2. Joints: Ball Sleeve compression type.

C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.

1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
2. Joints: Compression or barbed type.

2.09 CONTROL VALVES AND VALVE OPERATORS

A. Pressure Dependent Characterized Ball Valves (2-way & 3-way):

1. Up to 2 inches: Bronze body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats.
2. Manufacturers:
    a. Belimo.
    b. Bray / Delta Control Products.
    c. Honeywell.
    d. Schneider Electric Controls.

e. Johnson Controls.

f. Siemens

B. Globe Valves (2-way & 3-way):

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, single seated, screwed ends with backseating capability, repackable under pressure.

2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc, repackable under pressure.

3. Valve stem packing shall be tetrafluorethylene, spring loaded and self-adjusting. Packless construction is acceptable.

4. Manufacturers:

a. Belimo.

b. Bray / Delta Control Products.

c. Dodge Engineering & Controls, Inc.

d. Honeywell.

e. Schneider Electric Controls.

f. Johnson Controls.

g. Siemens.

C. Electric Operators:

1. Operators shall be electronic type to accept signals from direct digital controller or modulating thermostat for proportional control.

2. Valves shall spring return to normal position as indicated. Terminal unit tempering coil control valve operators are not required to be spring return.

3. Select with sufficient shut-off power for system pressure and highest operating torque, and torque requirements of valves which may stick because of infrequent use.

4. Select to provide smooth proportioning control under operating conditions normal to the system.

D. Hydronic Systems:

1. Valve minimum pressure rating shall meet or exceed the system minimum pressure rating as noted for each system in Division 20 Section “Valves,” and in Division 23 Section “Hydronic Piping.”

2. Valve minimum temperature ratings shall be 250 deg F.

3. For globe valves: Replaceable plugs and seats of stainless steel or brass, selected for maximum lift under application conditions.

4. Two-way and three- way valves shall have equal percentage characteristics. Size two way valve operators to close valves against pump shut off head.

5. Pressure independent control valves shall be used for 2-way applications unless otherwise indicated. Select to achieve scheduled flow rate of the associated heat transfer device. If the scheduled flow rate is too high to achieve with one valve, provide multiple valves sized at flow divided equally of the scheduled flow rate and control all valves in unison - coordinate control valve quantity and the need for parallel piping of control valves with mechanical contractor.

6. Pressure Drop for pressure dependent characterized ball and globe valves: Select Control valves that result in a pressure drop at or as close as possible to scheduled information. If not scheduled, primary HVAC equipment and terminal equipment control valves shall be

selected for a pressure drop close as possible to 11.5 feet of head (5 psig). TC Contractor shall use control valves that meet the pressure drop requirements from manufacturers listed above.

E. General Service Solenoid Valves:

1. Solenoid valves for reheat coils, radiant ceiling panels and unit heaters shall be 24 VDC, electronic-type, for two-position operation.

F. Natural Gas Solenoid Shutoff Valves:

1. Operation: Direct acting, electric solenoid operated, gas shutoff valve rated to be energized open when in service and closed (de-energized) when the EPO pushbutton is activated. Select valve solenoid coil electrical characteristics based on circuit power being provided. Valve shall be UL recognized component to Standard 429 – Electrically Operated Valves.
2. Description:
   a. Action: Normally closed – energize to open.
   b. Sizing: To close against the system pressure at “line-size.”
   c. Coordinate pipe connection style with the installation contractor.
   d. Heavy-duty assembly.
   e. Body: Brass for copper pipe and stainless steel for ferrous pipe.
   f. Seats and Discs: NBR or PTFE.
   g. Solenoid Enclosure: NEMA 250, Type 4.
3. Manufacturers:
   a. ASCO 2/2 Series Model 200-series Modular.
   b. Honeywell V4295 Series.

2.10 DAMPERS - AUTOMATED

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.

C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inches W.G. shall have minimum 3/4 inch solid shafts.

D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.

E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.

F. Jamb Seals: Stainless steel.

G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.

H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc plated.

I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.

J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.

K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.

L. Temperature Limits: -40 to 200 deg F.

M. Manufacturers:

1. American Warming & Ventilating.
2. Arrow United Industries.
3. Greenheck.
4. Honeywell.
5. Johnson Controls.
6. Louvers & Dampers, Inc.
7. Ruskin.
8. Tamco.
9. Vent Products.

2.11 **DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED**

A. Performance: AMCA certified for Air Performance and Air Leakage.

B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.

C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.

D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.

E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.

F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.

G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.

H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.

I. Leakage: Less than 3 CFM per square foot at 1 inch W.G. pressure differential at minus 40 deg F.

J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.

K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.

L. Temperature Limits: Minus 40 to 155 deg F.

M. Manufacturers:

1. Greenheck ICD-45.
2. Ruskin TED50 Series.
3. Tamco Series 9000 BF.

2.12 **DAMPER OPERATORS - ELECTRIC**

A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.

B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.

C. Manufacturers:

1. Belimo.
2. Delta Control Products.
3. Honeywell.
4. Schneider Electric Controls.
5. Johnson Controls.
6. Siemens.

2.13 DIFFERENTIAL PRESSURE SWITCHES

A. Shall provide electrical switching action upon a sensed pressure differential increase between two sensed points. Sensitivity shall be suitable for the application. Setpoint shall be adjustable over the full range of the device. Switching action shall open or close two independent single-pole, double-throw (SPDT) switches. Electrical switch rating shall be based on the application and circuit voltage.

B. Pressure rating of switch/connecting tubing and reset type:

1. Filter pressure drop - Rated for 2 inches w.g. Provide automatic reset type.
2. Duct static pressure - Rated for 10 inches w.g. Provide manual reset type when used for high limit cutout safety.

2.14 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.

B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.

C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.

E. Where raceway is required, two separate raceway systems shall be provided: one for A.C. wiring and the other for D.C. wiring.

F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

H. TC Contractor shall provide 24V power supply transformers for TC Contractor provided controllers. Maximum Transformer circuit for controls shall be 100VA serving controllers within mechanical room control panels or for remote terminal unit controllers served from common 24V power supply circuit. Transformers shall be located within enclosures provided by TC Contractor.

2.15 LIMIT SWITCHES

A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.

B. Manufacturers:

1. Allen-Bradley.
2. General Electric.
3. Square D.
4. Westinghouse.
5. Micro-switch.

2.16 **LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS**

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.

B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.

C. Panels shall be sized for a maximum fill of 50% capacity and shall not be smaller than 24" X 24".

2.17 **REFERENCE PROBE - DUCT STATIC PRESSURE**

A. Duct static pressure probe shall be capable of static pressure measurement with bi-directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.

B. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.

C. Manufacturers:

1. MAMAC # A-520.
2. Dwyer # A-305.
3. Tek-Air # T-SPP 7100/7200.

2.18 **REFERENCE PROBE - INDOOR STATIC PRESSURE**

A. Indoor pressure reference probe shall be a shielded static pressure sensor suitable for flush mounting in the ceiling, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, control tubing take-off fitting, and brush finish on exposed surface. Probe shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow of 1000 fpm from a radial source.

B. Manufacturers:

1. Air Monitor Corporation.
2. Tek-Air.

2.19 **THERMOSTATS – ELECTRONIC & ELECTRIC**

A. Line Voltage Room Thermostats: Adjustable single setpoint with exposed setpoint indicator and exposed thermometer for a range of 55 deg F to 85 deg F with maximum dead band of 1-1/2 degrees F and locking cover. Contacts shall be rated for load, single-pole or two-pole as required. Provide with integral manual On/Off/Auto selector switch where indicated on control details. Power Requirement: 24 V, ac or 120 V, ac as required.

B. Room Thermostat Accessories:

1. Thermostat Covers: Manufacturers standard with finish as selected by Architect.
2. Insulating Bases: Provide one inch insulating base for thermostats located on exterior walls.

3. Adjusting Key: As required for device.

C. Electric Low Limit Duct Thermostat (freezestat): Snap acting which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, fixed 5 deg F differential, range 30 deg F to 60 deg F, requiring minimum 20 feet length of bulb. Manual-reset unless indicated on drawings to be auto-reset type. Provide one thermostat for every 20 sq ft of coil surface. Switch shall be UL listed and rated for 10 amps at 120 VAC. Provide additional switch or contacts for connection to monitoring system.

D. Electric; strap-on piping type thermostat for control of fans with hot water heating coils. Operation of fan to be Off when temperature is below setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 Vac or 120 Vac duty as required

E. Manufacturers for listed Thermostat Types:

1. Honeywell International, Inc.
2. Johnson Controls, Inc.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc.; Building Technologies Division.

PART 3 EXECUTION

3.01 **INSTALLATION - CONTROL SYSTEMS**

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.

C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.

D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.

E. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.

F. Provide conduit and electrical wiring where required.

G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize “wiremold” routing.

H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.

I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.

J. Coil and conceal excess capillary on remote element instruments.

K. Install thermometers in air duct systems on flanges.

L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.

M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.

N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.

O. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.

P. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.

Q. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.

R. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.

S. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.

T. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

U. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.02 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor’s option to schedule a meeting at the Engineer’s Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.

B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer’s option to schedule a meeting at the Engineer’s Office to review the TC Contractor’s formally submitted drawings to address Engineer’s comments and concerns that indicate TC Contractor’s shop drawings vary from project design intent. This meeting can be avoided if TC Contractor’s shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.

C. Temperature Controls Installation Technician Meeting: Project Design Engineer’s option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor’s field installation technician and/or project manager. Discussion may include

1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
2. Graphics generation requirements including special Owner requirements and schedule for completion.
3. Owner training agenda and scheduling.
4. TC/BAS system acceptance procedures.

3.03 IDENTIFICATION AND MARKING

A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear

or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.

B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.

C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.

D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.

3.04 **GRAPHIC DISPLAY GENERATION**

A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:

1. Overall campus layout which shows all of the buildings on the Owner's campus.
2. Individual building layout or isometric for each building connected to the system.
3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
    a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
    b. System name.
    c. Area served.
    d. Present value or status of all inputs, along with present setpoint.
    e. Present percent open for each damper, valve, etc. based on commanded position.
    f. Reset schedule parameters for all points, where applicable.
    g. Present occupancy mode.
    h. Present economizer mode, where applicable.
    i. Present outside air temperature.
    j. Associated space conditions and setpoints, where applicable.
    k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
    l. Color coding to indicate normal and abnormal values, alarms, etc.
5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc.) shall be provided. Graphic display of output point auto or manual override status shall be provided.
6. Sequence of operation in written (text) format for each HVAC system.
7. Overall BAS system schematic.

8. System management graphic for each network device and/or DDC controller.

3.05 **OWNER INSTRUCTION AND TRAINING**

A. Provide a minimum of forty (40) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.

B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.

C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

D. Provide 5 sets of computer training & tutorial material on USB Flash Drives describing operator's BAS graphical interface capabilities and functions.

E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.06 **CALIBRATION AND START-UP**

A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.

B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.07 **ACCEPTANCE PROCEDURE**

A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.

B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.

D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION

SECTION 23 2113 - HYDRONIC PIPING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 2
1.03 PERFORMANCE REQUIREMENTS 2
1.04 SYSTEMS DESCRIPTIONS 2
1.05 ACTION SUBMITTALS 2
1.06 INFORMATIONAL SUBMITTALS 3
1.07 CLOSEOUT SUBMITTALS 3
1.08 QUALITY ASSURANCE 3
PART 2 PRODUCTS 3
2.01 COPPER TUBE AND FITTINGS 3
2.02 STEEL PIPE AND FITTINGS 4
2.03 SCHEDULE 10S STAINLESS-STEEL PIPE AND FITTINGS 4
2.04 SCHEDULE 40 STAINLESS-STEEL PIPE AND FITTINGS 5
2.05 JOINING MATERIALS 5
2.06 VALVES 5
2.07 SPECIALTY VALVES 6
2.08 STAINLESS-STEEL VALVES 9
2.09 CONTROL VALVES 10
2.10 AIR CONTROL DEVICES 10
2.11 HYDRONIC PIPING SPECIALTIES 12
2.12 HYDRONIC PIPING STRAINERS 12
2.13 STAINLESS STEEL STRAINERS 13
PART 3 EXECUTION 14
3.01 PIPING SYSTEMS INSTALLATION 14
3.02 HANGERS AND SUPPORTS 15
3.03 PIPE JOINT CONSTRUCTION 16
3.04 HYDRONIC SPECIALTIES INSTALLATION 16
3.05 FIELD QUALITY CONTROL 17

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
3. Division 20 Section “Mechanical General Requirements.”
4. Division 20 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
5. Division 20 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
6. Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”
7. Division 20 Section "Meters and Gages" for thermometers, flow meters, flow measuring devices, and pressure gages.

8. Division 20 Section "Mechanical Identification" for labeling and identifying hydronic piping.
9. Division 23 Section "General-Duty Valves for HVAC" for general-duty gate, globe, ball, butterfly, and check valves.
10. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
11. Division 23 Section "Temperature Controls" for temperature-control valves and sensors.
12. Division 23 Section “Piping Systems Flushing and Chemical Cleaning.”
13. Division 23 HVAC water treatment sections.

1.02 **DEFINITIONS**

A. CPVC: Chlorinated polyvinyl chloride.

B. HDPE: High density polyethylene.

C. PP: Polypropylene.

D. PVC: Polyvinyl chloride.

E. PTFE: Polytetrafluoroethylene.

F. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

G. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.03 **PERFORMANCE REQUIREMENTS**

A. Where not indicated on the Drawings, hydronic piping components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. Hot-Water Heating Piping: 125 psig at 200 deg F.
2. Condensate-Drain Piping: 150 deg F.
3. Air-Vent Piping: 200 deg F.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.04 **SYSTEMS DESCRIPTIONS**

A. Hydronic piping system materials are scheduled on the Drawings.

B. Refer to Application Schedule on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
2. Drain Duty: Hose-end drain valves.

1.05 **ACTION SUBMITTALS**

A. Product Data: For each type of the following:

1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air control devices.
3. Chemical treatment.
4. Hydronic specialties.
5. Pressure-seal fittings.

1.06 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Detail, at minimum 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

B. Qualification Data: For Installer.

1.07 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation and maintenance manuals.

1.08 **QUALITY ASSURANCE**

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

B. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

PART 2 PRODUCTS

2.01 **COPPER TUBE AND FITTINGS**

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. DWV Copper Tubing: ASTM B 306, Type DWV.

C. Wrought-Copper Socket Fittings: ASME B16.22.

D. Wrought-Copper Unions: ASME B16.22.

E. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASC Engineered Solutions; Gruvlok; CTS Copper System.

b. Victaulic Company; Style 606 and Style 607.

2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.

3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

F. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ASC Engineered Solutions; Anvil Press.

b. Apollo Valves; by Conbraco Industries; ApolloXpress.

c. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.

d. NIBCO Inc.; Press System.

e. Viega North America; ProPress System.

2. Housing: Copper.

3. O-Rings and Pipe Stops: EPDM.

4. Tools: Manufacturer's special tools.

5. Minimum 200-psig working-pressure rating at 250 deg F.

G. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. T-DRILL Industries Inc.

2.02 STEEL PIPE AND FITTINGS

A. Schedule 40 Steel Pipe: ASTM A 53/A 53M or ASTM A 106, Type E or S, Grade A or B. Include ends matching joining method.

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.

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.

4. Cast-Iron Flanges: ASME B16.1, Class 125.

5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.

B. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASC Engineered Solutions; Gruvlok; Model 7401 Rigid, Model 74 SlideLOK, and Fig. 7400 Rigidlite.

b. Victaulic Company; Style 107 QuickVic Rigid Coupling and W07 AGS Rigid Coupling.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.

4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.03 SCHEDULE 10S STAINLESS-STEEL PIPE AND FITTINGS

A. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L, seamless or electric resistance welded pipe.

B. Fittings: ASTM A 403/A 403M, Class S, seamless fittings matching pipe thickness and grade, for welded joints.

C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 304L stainless steel.

D. Grooved-Joint Systems:

1. Manufacturers:

a. ASC Engineered Solutions; Gruvlok Manufacturing; Model 7400SS.

b. Victaulic Company; Style 489.

2. Grooved-End, Stainless Steel-Piping Fittings: Schedule 10S, Type 304L or 316L stainless steel from material conforming to ASTM A 403 or pipe conforming to ASTM A 312, or sheet conforming to ASTM A 240; with dimensions matching stainless steel pipe.

3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.

4. Grooved-End, Stainless Steel-Piping Couplings: ASTM A 743, cast Type 316L stainless steel, and stainless steel bolts and nuts.

a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.04 SCHEDULE 40 STAINLESS-STEEL PIPE AND FITTINGS

A. Stainless-Steel Pipe: Schedule 40, ASTM A 312/A 312M, Type 316L, seamless or electric resistance welded pipe.

B. Fittings: ASTM A 403/A 403M, Class S, seamless fittings matching pipe thickness and grade, for welded joints.

C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 316L stainless steel.

D. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASC Engineered Solutions; Gruvlok; Fig. 472 and Fig. 770.

b. Victaulic Company; Style 489.

2. Joint Fittings: Schedule 40S, Type 304L or Type 316L conforming to ASTM A 403/A 403M with grooves or shoulders constructed to accept grooved-end couplings.

3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.

4. Couplings: ASTM A 351, A 743 and A 744 Grade CF8M Type 316 stainless steel housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.05 JOINING MATERIALS

A. Refer to Division 20 Section “Basic Mechanical Materials and Methods.”

2.06 VALVES

A. General Service Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC."

2.07 **SPECIALTY VALVES**

A. Balance Valves:

1. Balance Valves NPS 6 and Larger: Lug type butterfly valves with aluminum bronze disc, AISI 300 Series stainless steel stem, resilient replaceable seat for service at not less than 250 deg Fand memory stops. Refer to Division 23 Section “General-Duty Valves for HVAC” for additional requirements.
    a. Provide lubricated enclosed screw or worm gear operator with handwheel for sizes 6 inches and larger.
    b. Pressure rating shall meet or exceed system minimum pressure rating.
2. Flow Measuring: Use Flow Measuring Devices as specified in Division 20 Section “Meters and Gages.”
3. Balance Valves for Sizes Less than NPS 6 Combination balance valve and flow measuring device as specified in this Section.

B. Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Griswold Controls.
    b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
    c. IMI Flow Design; IMI Hydronic Engineering Inc.
    d. Jomar Hydronics.
    e. Macon Balancing; Tunstall Corporation.
    f. Nexus Valve.
    g. PRO Hydronic Specialties, LLC.
2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
    a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
    b. ASC Engineered Solutions; Gruvlok; Model CBV.
3. Body: Brass or bronze, ball or plug type with calibrated orifice or venturi.
4. Ball: Plated brass, or stainless steel.
5. Plug: Resin.
6. Seat: PTFE.
7. End Connections: Threaded or socket.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. WOG Rating: Minimum 400 psig.
11. Maximum Operating Temperature: 250 deg F.

C. Combination, Balancing Valves and Flow Measuring Devices NPS 2-1/2 through NSP 4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Griswold Controls.

b. Hydronic Components, Inc. (HCi); a Jomar Group Company.

c. IMI Flow Design; IMI Hydronic Engineering Inc.

d. Jomar Hydronics.

e. Macon Balancing; Tunstall Corporation.

f. Nexus Valve.

g. PRO Hydronic Specialties, LLC.

2. Manufacturers: Subject to compliance with requirements, use products by one of the following:

a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.

b. ASC Engineered Solutions; Gruvlok; MBV Series, CSV Series.

3. Body: Cast-iron or steel body, ball, plug, butterfly, or globe pattern with calibrated orifice or venturi.

4. Stem Seals: EPDM O-rings.

5. Disc: Glass and carbon-filled PTFE.

6. Seat: PTFE.

7. End Connections: Flanged or grooved.

8. Pressure Gage Connections: Integral seals for portable differential pressure meter.

9. Handle Style: Lever, with memory stop to retain set position.

10. WOG Rating: Minimum 200 psig.

11. Maximum Operating Temperature: 225 deg F.

D. Contractor Option for Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller: Preassembled coil hook up kits may be used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Griswold Controls.

b. Hydronic Components, Inc. (HCi); a Jomar Group Company.

c. IMI Flow Design; IMI Hydronic Engineering Inc.

d. Jomar Hydronics.

e. Macon Balancing; Tunstall Corporation.

f. Nexus Valve.

g. PRO Hydronic Specialties, LLC.

2. Manufacturers: Subject to compliance with requirements, use products by one of the following:

a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.

b. ASC Engineered Solutions; Gruvlok.

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Assist Operated Relief Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Anderson Greenwood & Co.; Kunkle Valve Division.
   c. Armstrong Pumps, Inc.
   d. Bell & Gossett; Xylem Inc.; Models 790 and 1170.
   e. Conbraco Industries, Inc.; Apollo Valve.
   f. Spence Engineering Company, Inc.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: EPDM.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPDM.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Relief Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.

b. Anderson Greenwood & Co.; Kunkle Valve Division.

c. Armstrong Pumps, Inc.

d. Bell & Gossett; Xylem Inc.; 3301 and 4100.

e. Conbraco Industries, Inc.; Apollo Valve.

f. Spence Engineering Company, Inc.

g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Cast iron.

3. Disc: Glass and carbon-filled PTFE.

4. Seat: EPDM.

5. Stem Seals: EPDM O-rings.

6. Diaphragm: EPDM.

7. Wetted, Internal Work Parts: Brass and rubber.

8. Valve Seat and Stem: Noncorrosive.

9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Griswold Controls.

b. IMI Flow Design; IMI Hydronic Engineering Inc.

2. Body: Brass or ferrous metal.

3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.

4. Combination Assemblies: Include bonze or brass-alloy ball valve.

5. Identification Tag: Marked with zone identification, valve number, and flow rate.

6. Size: Same as pipe in which installed.

7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.

8. Minimum Pressure Rating: 300 psig.

9. Maximum Operating Temperature: 250 deg F.

2.08 STAINLESS-STEEL VALVES

A. Ball Valves, NPS 2 and Smaller: MSS SP-110, 600-psig minimum CWP, 2-piece, with stainless-steel body, conventional-port stainless-steel ball, PTFE seals, and threaded or weld ends.

1. Manufacturers:

a. Apollo Valves; by Conbraco Industries.

b. Metso Automation, Inc.; Jamesbury.

c. NIBCO INC.

d. Velan Valve Corp. USA.

B. Ball Valves, NPS 3 and Larger: MSS SP-72, Class 150, 2 piece, with stainless-steel body, stainless-steel ball, PTFE seals, and flanged or butt-welding ends.

1. Manufacturers:
    a. Apollo Valves; by Conbraco Industries.
    b. Metso Automation, Inc.; Jamesbury.
    c. NIBCO INC.
    d. Velan Valve Corp. USA.

C. Stainless Steel, Dual-Plate Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. DeZurik/APCO/Hilton; APCO Willamette Valve and Primer Corporation.
    b. Champion Valves, Inc.
    c. Crane Co.; Crane Valve Group; Crane Valves.
    d. Mueller Steam Specialty; a division of SPX Corporation.
    e. Val-Matic Valve & Manufacturing Corp.
2. Description:
    a. ASME Pressure Class: Class 150.
    b. Body Design: Lug type, with spring-loaded plates.
    c. Body and Disc Material: Type 316 stainless steel.
    d. Spring Material: Type 316 stainless steel.
    e. Seat: EPDM.

2.09 CONTROL VALVES

A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Temperature Controls."

B. Calibrated orifice balancing valves shall not be required on devices where pressure independent characterized control valves (PICCV’s) are installed.

2.10 AIR CONTROL DEVICES

A. Manual Air Vents: Use ball-valve-type hose-end drain valves, refer to Division 23 Section “General-Duty Valves for HVAC.”

B. Automatic Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett; Xylem Inc.
    d. Spirotherm, Inc.
    e. Taco, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.

6. Discharge Connection: NPS 1/4.
7. Maximum Operating Pressure: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

C. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett; Xylem Inc.
   d. Taco, Inc.
   e. Wessels Co.
2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Combination Air and Dirt Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bell & Gossett; Xylem Inc.; Model CRS.
   b. Spirotherm, Inc.
   c. Taco, Inc.; Series 4900-AD
   d. Wessels Company; Wess-Vent Air & Dirt Separator.
2. Body: Fabricated steel; constructed for 125-psig maximum working pressure and 250 deg F maximum operating temperature. Separator shall have body extended below pipe connections for dirt separation.
3. Air and Dirt Separation Mechanism: Internal stainless steel coalescing medium; or copper core tube with continuous wound copper medium permanently attached followed by continuous wound copper wire permanently affixed; or PALL ring technology.
4. Venting Chamber: With integral full port, float actuated brass venting mechanism. Include valved side tap to flush floating dirt or liquids and for quick bleeding of air during system fill.
5. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded.
7. Size: Match system flow capacity.

E. In-Line Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.

c. Bell & Gossett; Xylem Inc.

d. Taco, Inc.

2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.

3. Maximum Working Pressure: Up to 175 psig.

4. Maximum Operating Temperature: Up to 300 deg F.

F. Air Purgers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amtrol, Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett; Xylem Inc.

d. Taco, Inc.

2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.

3. Maximum Working Pressure: 150 psig.

4. Maximum Operating Temperature: 250 deg F.

2.11 HYDRONIC PIPING SPECIALTIES

A. Flexible connectors and expansion fittings are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

B. Waterless Condensate Trap:

1. Meet standard building code requirements.

2. Predesigned to prevent:

a. Possibility of frozen or broken pipes.

b. Standing water within trap.

c. Sludge buildup in trap.

d. Geyser effect or blowout.

3. Manufacturers:

a. Des Champs Technologies; HVAC Air Trap; P-Series, N-Series, and RLC Series.

2.12 HYDRONIC PIPING STRAINERS

A. Manufacturers:

1. Apollo Valves; Conbraco Industries, Inc.

2. Griswold Controls.

3. Keckley Company.

4. Metraflex Company.

5. Mueller Steam Specialty; a Watts Brand.

6. NIBCO, Inc.

7. Sure Flow Equipment Inc.

8. Titan Flow Control, Inc.

9. Watts.
10. Yarway; Emerson Automation Solutions.
11. ASC Engineered Solutions; Gruvlok Manufacturing (for grooved piping).
12. Victaulic Company (for grooved piping).

B. Y-Pattern Strainers, Bronze:

1. CWP: 200 psig minimum, unless otherwise indicated.
2. SWP: 125 psig minimum, unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller.
4. End Connections: Threaded or soldered.
5. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
6. Drain:
    a. Pipe plug for sizes NPS 2 and smaller.
    b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

C. Y-Pattern Strainers, Cast and Ductile Iron:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger; grooved ends may be used on grooved piping.
3. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain:
    a. Pipe plug for sizes NPS 2 and smaller.
    b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

D. Basket Strainers, Cast Iron:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain: Pipe plug.

2.13 STAINLESS STEEL STRAINERS

A. Manufacturers:

1. Apollo Valves; Conbraco Industries, Inc.
2. Keckley Company.
3. Metraflex Company.
4. Mueller Steam Specialty; a Watts Brand.
5. NIBCO, Inc.

6. Sure Flow Equipment Inc.
7. Titan Flow Control, Inc.
8. Watts.
9. Yarway; Emerson Automation Solutions.

B. Y-Pattern Strainers:

1. Body: ASTM A 351, Type 316 stainless steel, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. SWP Rating: 250-psig steam working pressure.

C. Basket Strainers:

1. Body: ASTM A 351, Type 316 stainless steel, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. SWP Rating: 250-psig steam working pressure.

PART 3 EXECUTION

3.01 PIPING SYSTEMS INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping, other than drain piping, at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC."

Q. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

R. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

S. Install check valves at each pump discharge and elsewhere as required to control flow direction.

T. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

U. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

V. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

W. Install flanges or grooved mechanical couplings in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

X. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and where indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

Y. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

Z. Identify piping as specified in Division 20 Section "Mechanical Identification."

3.02 **HANGERS AND SUPPORTS**

A. Hanger, support, and anchor devices are specified in Division 20 Section "Hangers and Supports." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
7. NPS 4 to NPS 5: Maximum span, 10 feet minimum rod size, 1/2-inch.
8. NPS 6: Maximum span, 10 feet minimum rod size, 5/8-inch.
9. NPS 8: Maximum span, 10 feet minimum rod size, 3/4-inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.03 PIPE JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Glycol Systems:

1. Install automatic air vents on expansion tanks and install high capacity automatic air vents on air separators. Route vent piping to spill over glycol fill station.
2. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install combination air/dirt separator in pump suction. Install blowdown piping with ball valve; extend full size to nearest floor drain.

E. Install expansion tanks as indicated in piping diagrams. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.

2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.05 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 2 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation.

3. Remove disposal fine-mesh strainers in pump suction diffusers.

4. Set makeup pressure-reducing valves for required system pressure.

5. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

6. Set temperature controls so all coils are calling for full flow.
7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
8. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 23 2510 - PIPING SYSTEMS FLUSHING AND CHEMICAL CLEANING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 PERFORMANCE REQUIREMENTS 1
1.05 ACTION SUBMITTALS 2
1.06 INFORMATIONAL SUBMITTALS 2
1.07 CLOSEOUT SUBMITTALS 2
1.08 QUALITY ASSURANCE 2
1.09 COORDINATION 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 MATERIALS 2
2.03 GEOTHERMAL LOOP FLUSHING EQUIPMENT 3
PART 3 EXECUTION 3
3.01 ACCEPTABLE SERVICE PROVIDER 3
3.02 PREPARATION 3
3.03 INITIAL FLUSHING 3
3.04 FLUSHING AND CHEMICAL CLEANING PROCEDURES 4
3.05 PLACING INTO OPERATION 4
3.06 FIELD QUALITY CONTROL 5

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section “Domestic Water Piping,” for disinfection of potable water piping.
4. Division 23 Section "Hydronic Piping.”
5. Division 23 water treatment sections.

1.02 SUMMARY

A. This Section includes chemical cleaning for the following piping systems:

1. Heat Pump Loop Water

1.03 DEFINITIONS

A. Cleaning: Recirculating water containing chemical cleaning and passivation compounds.

B. Flushing: Using approved water on a once through basis.

1.04 PERFORMANCE REQUIREMENTS

A. Furnish the services of a firm specializing in piping system chemical cleaning and water treatment work.

1. For chemical cleaning: This firm shall select the required type and quantity, based on system volume, of cleaning compound, and method of application.

B. Passivation for Galvanized Steel: Open loop only, for the first two weeks of operation.

1.05 **ACTION SUBMITTALS**

A. Product Data:

1. Proposed cleaning chemicals and quantities.

2. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

1.06 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Reduced scale plans indicating locations of velocity measurements.

B. Other Informational Submittals:

1. Proposed, step-by-step, chemical cleaning procedure.

2. Circulation pump suction and discharge pressure at start and completion of chemical cleaning operations.

1.07 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

1.08 **QUALITY ASSURANCE**

A. Service Provider Qualifications: An experienced piping systems cleaning service provider capable of applying cleaning compounds as specified in this Section.

B. Conduct safety meetings with Owner’s Representative and personnel involved in the cleaning process.

C. Assume responsibility for damage, necessary subsequent cleaning, flushing, and inspection of Work under the Contract which results from improper flushing and cleaning operations including failure to flush all dead-ends.

1.09 **COORDINATION**

A. Schedule flushing and chemical cleaning activities immediately after piping system pressure testing and immediately prior to piping system chemical treatment work to minimize internal oxidization or flash corrosion of piping systems.

B. Coordinate chemical cleaning work with other work to avoid accidental chemical discharge, spillage, or spray out, and electrolytically originated system damage resulting from concurrent chemical cleaning and arc welding.

C. Coordinate with work performed under other Sections to provide in-place temporary strainers, spool pieces, flushing hose connections, cross-over piping, and isolation and drain valves.

D. Chillers shall not be cleaned with any chloride component.

E. Boilers shall be flushed and cleaned to remove rust and oil deposits.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. System Cleaning Chemicals: Subject to compliance with requirements, provide products by one of the following:

1. H-O-H Chemicals, Inc.

2.02 **MATERIALS**

A. Cleaning chemicals shall be as recommended by manufacturer and compatible with piping system components and connected equipment.

B. Cleaning and passivation chemical shall consist of an inorganic phosphate, yellow metal corrosion inhibitor (Tolytriazole), dispersant, and oil emulsifier.

C. Provide additional temporary and permanent piping, equipment, and materials required for chemical cleaning work.

D. Use potable water for flushing and cleaning operations, unless directed otherwise by the Architect.

2.03 **GEOTHERMAL LOOP FLUSHING EQUIPMENT**

A. Manufacturer/Supplier: Subject to compliance with requirements, provide products by one of the following:

1. Geothermal Supply Company; Purge Pro Max.

B. Furnish trailer-mounted commercial flushing and purging system designed for geothermal applications and having the following capabilities:

1. Flush and filter debris from system.
2. Purge trapped air bubbles.
3. Reverse flow.
4. Hydrostatically pressure test.
5. Flow test.

PART 3 EXECUTION

3.01 **ACCEPTABLE SERVICE PROVIDER**

A. Subject to compliance with requirements, provide chemical cleaning service by one of the following:

1. H-O-H Chemicals, Inc. David Burton/H.V. Burton Co, 734-261-4220.

3.02 **PREPARATION**

A. Prior to flushing and cleaning activities, drain the system of all water used for hydrostatic testing.

B. Temporarily connect dead-end supply and return piping as necessary to result in recirculating system in which no lines are left static for purposes of flushing and cleaning. Refer to System Piping Diagrams on the Drawings for suggested locations of temporary connections for flushing and cleaning purposes.

C. Select three locations for monitoring flow rates.

3.03 **INITIAL FLUSHING**

A. Remove loose dirt, mill scale, metal chips, weld beads, rust and other deleterious substances without damage to system components.

B. Bypass factory cleaned equipment, unless acceptable means of protection are provided and subsequent inspection of water boxes and other "hide-out" areas takes place.

C. Isolate or protect clean system components including pumps and pressure vessels and remove components which may be damaged.

D. Open valves, drains, vents and strainers at all system levels.

E. Remove plugs, caps, spool pieces and components to facilitate early discharge from system.

F. Sectionalize system if possible to obtain debris carrying velocity of 6 FPS.

G. Connect dead-end supply and return headers as necessary or provide terminal drains in end caps.

H. Install temporary strainers where necessary to protect down-stream equipment.

I. Supply and remove flushing water and drainage by fire hoses, garden hoses, temporary and permanent piping and Contractor's booster pumps.

J. Flush for not less than one hour.

K. Inspect system including basins to determine if debris accumulation requires dewatering and cleaning prior to next phase work.

3.04 **FLUSHING AND CHEMICAL CLEANING PROCEDURES**

A. Remove without chemical or mechanical damage to system components adherent dirt (organic soil), oil and grease (hydrocarbons), welding and soldering flux, mill varnish, pipe compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing. Removal of tightly adherent mill scale is not required.

B. Fill system with fresh water and add manufacturer’s recommended volume of system cleaner to remove grease and petroleum products from piping. Circulate solution for 48 hours at a minimum velocity of 6 fps.

1. Utilize defoamers to preclude damage to existing work and adjacent electrical equipment.

2. Utilize heat to maximize effectiveness of compounds or use live steam injection where practical and safe. Do not raise cleaning water temperature in excess of controlled limits.

C. Monitor flow rates and clean strainers as required to maintain minimum specified velocity during the entire circulation and chemical cleaning period.

D. Install temporary strainer screens between pipe flange faces where necessary to protect primary system from branch connections during chemical cleaning procedures.

E. Following chemical cleaning:

1. Remove, clean, and reinstall strainer baskets.

2. Blow down and clean low points, dirt legs, and traps.

F. Drain systems:

1. Check with local authorities concerning discharge requirements and submit copies of letters or reports.

2. If acceptable, drain system to sanitary drainage system.

3. Do not under any circumstances drain to storm drainage system or open drainage ditch.

4. If discharge requirements do not allow discharge to sanitary sewer, secure the services of a licensed disposal Contractor.

5. Disposal Contractors:

a. Dynecol.

b. SQS Environmental.

G. Perform final flush to remove any remaining debris and chemical from the system:

1. Flush dead ends and isolated pre-cleaned equipment.

2. Operate valves to dislodge debris in valve body.

3. Flush for not less than 1 hour.

3.05 **PLACING INTO OPERATION**

A. Clean strainers.

B. Dewater and clean new sumps, basins, storage vessels and pressure vessels.

C. Disassemble, inspect, clean, repair, replace and reassemble any critical component or questionable item. Bellows style, and hose and braid flexible connectors left in place shall be removed and cleaned.

D. Preliminarily adjust control valves.

E. Install clean primary filter elements, if necessary, as determined by both pressure differential across filter and visual inspection of filter elements.

F. Close-up and fill system as soon as possible to minimize corrosion of untreated surfaces.

G. Vent air from system and adjust fill valve.

H. Immediately after completion of flushing and chemical cleaning, fill systems with potable water and make ready for chemical treatment as specified in Division 23 Section “HVAC Water Treatment.”

3.06 **FIELD QUALITY CONTROL**

A. Tests and Inspections:

1. Withdraw, inspect, and test samples of water from each system after flushing and chemical cleaning is completed, to ensure system is free of contaminants.

2. If loose debris or contaminants are still present, repeat final flushing procedures until test samples and strainers remain free of debris and contaminants.

END OF SECTION

SECTION 23 3113 - METAL DUCTS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 SYSTEM DESCRIPTION 2
1.05 PERFORMANCE REQUIREMENTS 2
1.06 ACTION SUBMITTALS 2
1.07 INFORMATIONAL SUBMITTALS 2
1.08 CLOSEOUT SUBMITTALS 3
1.09 QUALITY ASSURANCE 3
1.10 COORDINATION 3
PART 2 PRODUCTS 3
2.01 MANUFACTURERS 3
2.02 SHEET METAL MATERIALS 3
2.03 ZERO-CLEARANCE PREFABRICATED RANGE HOOD EXHAUST DUCT 4
2.04 DUCT LINER 4
2.05 SEALANTS AND GASKETS 5
2.06 HANGERS AND SUPPORTS 6
2.07 ROOF MOUNTED DUCT SUPPORTS 7
2.08 RECTANGULAR DUCT FABRICATION 7
2.09 APPLICATION OF LINER IN RECTANGULAR DUCTS 8
2.10 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION 9
2.11 DOUBLE-WALL ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION 11
PART 3 EXECUTION 11
3.01 DUCTWORK APPLICATION SCHEDULE 11
3.02 DUCT INSTALLATION 11
3.03 INSTALLATION OF EXPOSED DUCTWORK 12
3.04 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS 12
3.05 DUCT SEALING 13
3.06 HANGER AND SUPPORT INSTALLATION 13
3.07 CONNECTIONS 13
3.08 PAINTING 14
3.09 FIELD QUALITY CONTROL 14
3.10 START UP 14

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 SUMMARY

A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

1.03 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.

C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm.

D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm.

E. FRP: Fiberglass-reinforced plastic.

F. PVC: Polyvinyl Chloride.

1.04 **SYSTEM DESCRIPTION**

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 **PERFORMANCE REQUIREMENTS**

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Application Schedule" Article.

1.06 **ACTION SUBMITTALS**

A. Shop Drawings: Drawn to scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevations of top and bottom of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

1.07 **INFORMATIONAL SUBMITTALS**

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.08 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

1.09 **QUALITY ASSURANCE**

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

C. Duct Liner Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.10 **COORDINATION**

A. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

B. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **SHEET METAL MATERIALS**

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.

E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

F. Reinforcement Shapes and Plates:

1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

2. Compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods:

1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.

2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches.

2.03 ZERO-CLEARANCE PREFABRICATED RANGE HOOD EXHAUST DUCT

A. Manufacturers:

1. AMPCO; American Metal Products; Model IVSI-4ZC.
2. Metal-Fab Inc.; Model IPIC-3G/4G.
3. Schebler Chimney Systems; FyreGuard.
4. Selkirk Inc.; Selkirk Metalbestos; ZeroClear Z3.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211, and suitable for zero-clearance installations.

C. Construction: Inner shell and outer jacket separated by a 3-inch to 4-inch annular space filled with high-temperature, ceramic-fiber insulation.

1. Inner Shell: ASTM A 666, Type 304 stainless steel.
2. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors. Seams shall be fully welded.

D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at 1500 deg F minimum.

E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.

F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.

G. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.

1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code.
2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.

2.04 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.

1. Manufacturers:
   a. CertainTeed Corp.; Insulation Group.
   b. Johns Manville International, Inc.
   c. Knauf Fiber Glass GmbH.
2. Materials: ASTM C 1071, Type I, flexible; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
   a. Thickness: 1 inch.
   b. Density: 1-1/2 pounds per cubic foot.
   c. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.

d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

e. Maximum Operating Temperature: 250 deg F when tested according to ASTM C 411.

f. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

g. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.

2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.

3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

3. Noise reduction coefficient (NRC): Sound absorption coefficients shall not be less than those in the table below as tested by ASTM C423 using an ASTM E795 Type A mounting.

	Sound absorption coefficients at octave band center frequencies, Hz						
Thickness Inches	125	250	500	1000	2000	4000	NRC
1	.08	.31	.59	.84	.91	.90	.70

2.05 **SEALANTS AND GASKETS**

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.

1. Manufacturers:

a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.

C. Solvent-Based Joint and Seam Sealant:

1. Manufacturers:

a. Hardcast; Sure-Grip 404.

b. United McGill.

2. Application Method: Brush on.

3. Base: Synthetic rubber resin.

4. Solvent: Toluene and heptane.

5. Solids Content: Minimum 60 percent.

6. Shore A Hardness: Minimum 60.

7. Water resistant.

8. Mold and mildew resistant.

9. VOC: Maximum 395 g/L.

10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.

11. Service: Indoor or outdoor.

12. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated 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.

2.06 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.

1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
   a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
   b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.

4. Manufacturers:
    a. B-Line by Eaton; KwikWire.
    b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
    c. Duro Dyne Corp.; Dyna-Tite System.
    d. Gripple Inc.; Hang-Fast System.

F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
    a. Stainless steel complying with ASTM A 492.
2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
3. End Fixings:
    a. Loop End: Type 316L/A4 stainless steel.
    b. Stud or Toggle End: Type 304L/A2 stainless steel.
    c. Plain end suitable for stainless steel wire rope beam clamp.
4. Manufacturers:
    a. B-Line by Eaton; KwikWire.
    b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
    c. Duro Dyne Corp.; Dyna-Tite System.
    d. Gripple Inc.; Hang-Fast System.

G. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.

2.07 ROOF MOUNTED DUCT SUPPORTS

A. General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted duct.

B. Support: Assembly of bases, and vertical and horizontal members, for roof installation without membrane penetration.
1. Manufacturer:
    a. B-Line by Eaton.
    b. Eco Support Products.
    c. MIFAB, Inc.; C-Port.
    d. MIRO Industries.
    e. Pentair Electrical & Fastening Solutions; CADDY.
    f. Portable Pipe Hangers.
2. Bases: Two or more plastic, stainless steel, or recycled rubber.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.

2.08 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless

otherwise indicated. For metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", unless otherwise indicated.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Nexus Inc.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.09 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. 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.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. 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.

G. 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:

1. Fan discharges.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

H. Where double-wall rectangular duct is indicated:

1. 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.

2. 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.

2.10 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.

1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.

1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

D. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.

3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.

4. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.

5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)

1. Fabricate according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless otherwise indicated.

F. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)

1. Geometry of fittings shall be according to SMACNA's HVAC Duct Construction Standards–Metal and Flexible unless otherwise indicated.

2. Fittings shall be continuously welded, and shall be two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

3. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

G. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

H. Diverging-Branch Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

I. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
    a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
    c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
    a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
    b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
    c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

2.11 **DOUBLE-WALL ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION**

A. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
2. Insulation: 1-inch- thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
    a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:
    a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.
    b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
    c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
    d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.
4. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.
    a. Provide 1 mil mylar liner between acoustical insulation and perforated inner liner.
5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

B. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.

1. Solid Inner Ducts: Use the following sheet metal thicknesses:
    a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
    b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
    c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
2. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.

PART 3 EXECUTION

3.01 **DUCTWORK APPLICATION SCHEDULE**

A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.02 **DUCT INSTALLATION**

A. Install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."

1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.

O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

1. Intermediate level.

3.03 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.04 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through 2000 deg F temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.

D. Install welded test ports or prefabricated test port section in the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.

E. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.

F. Field Quality Control:

1. Prior to use or concealment of any portion of grease duct system, perform leakage test in presence of Code Official.

2. Light test or approved equivalent test method shall be performed to determine that welded and brazed joints are liquid tight.

3. Lamp shall be not less than 100 watts and shall be open to emit light equally in all directions perpendicular to duct walls.

3.05 DUCT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer’s instructions.

1. Seal Class: Refer to Application Schedule on the Drawings.

2. Seal ducts before external insulation is applied.

3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. 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.

C. 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 maximum intervals of 16 feet.

D. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.

E. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

F. Install roof mounted duct supports in accordance with manufacturer’s instructions. Provide additional membrane layer or walkpads under support bases as required.

G. Use load rated cable suspension system for round duct in exposed locations.

3.07 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.08 **PAINTING**

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.09 **FIELD QUALITY CONTROL**

A. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

B. Duct system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 **START UP**

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3300 - DUCT ACCESSORIES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 ACTION SUBMITTALS 2
1.04 INFORMATIONAL SUBMITTALS 2
1.05 CLOSEOUT SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
1.07 EXTRA MATERIALS 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 SHEET METAL MATERIALS 3
2.03 PRESSURE RELIEF DOORS 3
2.04 LOW PRESSURE MANUAL VOLUME DAMPERS 3
2.05 LOW PRESSURE MANUAL VOLUME DAMPERS (STAINLESS STEEL) 4
2.06 MOTORIZED CONTROL DAMPERS 5
2.07 FIRE DAMPERS (CURTAIN STYLE) 6
2.08 SMOKE DAMPERS 6
2.09 COMBINATION FIRE AND SMOKE DAMPERS 7
2.10 DUCT SILENCERS (FIBERGLASS FILL) 8
2.11 TURNING VANES 9
2.12 DUCT-MOUNTING ACCESS DOORS 10
2.13 GREASE DUCT ACCESS DOORS 10
2.14 FLEXIBLE CONNECTORS 11
2.15 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE 11
2.16 FLEXIBLE DUCT ELBOW SUPPORTS 12
2.17 DUCT ACCESSORY HARDWARE 12
2.18 FINISHES 13
PART 3 EXECUTION 13
3.01 APPLICATION AND INSTALLATION 13
3.02 FIELD QUALITY CONTROL 14
3.03 ADJUSTING 14

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section “Testing, Adjusting, and Balancing” for duct test holes.
3. Division 23 Section “Temperature Controls” for motorized control dampers.
4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.02 DEFINITIONS

A. NVLAP: National Voluntary Laboratory Accreditation Program.

B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.

C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.

D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

1.03 **ACTION SUBMITTALS**

A. Product Data: For each type of product indicated.

1. For turning vanes, include data for pressure loss generated sound power levels.

2. For duct silencers, include pressure drop and dynamic insertion loss data.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Control damper installations.

d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

e. Duct security bars.

f. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

C. Source quality-control reports.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.07 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed for each temperature rating.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **SHEET METAL MATERIALS**

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.

C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.

D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

E. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.03 **PRESSURE RELIEF DOORS**

A. Manufacturers:

1. KEES, Inc.
2. Pottorff.
3. Ruskin Company.

B. Description: Designed to open automatically to prevent exploding or imploding ductwork in the event dampers close while fan is still operating. Doors open outward for positive pressure relief, or inward for negative pressure relief.

C. Frame: 12 gage galvanized steel.

D. Door: 12 gage galvanized steel.

E. Seal: Polyurethane foam around door perimeter.

F. Pressure Relief Setting: Factory set, field adjustable, minimum 1.0 inch wg above normal system pressure.

G. Springs: Negator springs for door closure upon pressure relief and system shutdown.

H. Temperature Limits: Minus 40 deg F minimum, and 120 deg F maximum.

2.04 **LOW PRESSURE MANUAL VOLUME DAMPERS**

A. Manufacturers:

1. American Warming and Ventilating; Mestek, Inc.
2. Arrow United Industries; Mestek, Inc.
3. Greenheck Fan Corporation.
4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
5. Louvers and Dampers, Inc.; Mestek, Inc.
6. Nailor Industries Inc.
7. Ruskin Company.
8. Vent Products Co., Inc.
9. Young Regulator Co.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.

C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

F. Damper Materials:

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
5. Tie Bars and Brackets: Galvanized steel.

G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

H. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

I. Positive-Locking Damper Hardware:

1. Manufacturers:
   a. Duro Dyne Corporation; Dyna-Click.
   b. Rossi Hardware; Everlock.
   c. Windgate Products Co., Inc.; Sure-Loc & Sure-Loc HD.
2. Quadrant Material: 18 gage galvanized steel with 11 to 15 locking positions.
3. Handle material: Die-cast aluminum or flame-retardant high-strength polymer.
4. Include center hole to suit damper operating-rod size.
5. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.05 LOW PRESSURE MANUAL VOLUME DAMPERS (STAINLESS STEEL)

A. Manufacturers:

1. American Warming and Ventilating; Mestek, Inc.
2. Arrow United Industries; Mestek, Inc.
3. Greenheck fan corporation.
4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
5. Louvers and Dampers, Inc.; Mestek, Inc
6. Nailor Industries Inc.
7. Ruskin Company.

8. Vent Products Co., Inc.
9. Young Regulator Co.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.

C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

F. Damper Materials:

1. Steel Frames: Hat-shaped, stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, stainless sheet steel.
3. Blade Axles: Stainless steel.
4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
5. Tie Bars and Brackets: Aluminum.

G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

H. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

I. Positive-Locking Damper Hardware:

1. Manufacturers:
   a. Duro Dyne Corporation; Dyna-Click.
   b. Rossi Hardware; Everlock.
   c. Windgate Products Co., Inc.; Sure-Loc & Sure-Loc HD.
2. Quadrant Material: 18 gage galvanized steel with 11 to 15 locking positions.
3. Handle material: Die-cast aluminum or flame-retardant high-strength polymer.
4. Include center hole to suit damper operating-rod size.
5. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.06 MOTORIZED CONTROL DAMPERS

A. Refer to Division 23 Section “Temperature Controls.”

2.07 **FIRE DAMPERS (CURTAIN STYLE)**

A. Manufacturers:

1. Air Balance, Inc.; Mestek, Inc
2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.

D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Fusible Links: Replaceable, 212 deg F rated.

2.08 **SMOKE DAMPERS**

A. Manufacturers:

1. Air Balance, Inc.; Mestek, Inc
2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. General Description: Smoke dampers with airfoil blades, labeled according to UL 555S, with minimum Class II leakage rating.

C. Frame and Blades: 16 gage, galvanized sheet steel.

D. Mounting Sleeve: Factory-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

E. Rated pressure and velocity to exceed design airflow conditions.

F. Damper Actuators: Electric modulating or two-position action as required.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
2. Size for torque required for damper seal at load conditions.

3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (coordinate with Controls contractor).
6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
8. Actuator timing shall meet 15 sec.
9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.

G. Damper blade position end switches: Factory installed damper position switch package for both full open and full closed indication (equivalent to Ruskin SP100 switch package).

H. Test Switch: Damper mounted momentary “test” push-button switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.

1. Include damper mounted “open” and “closed” indication lights on switch plate for connection to factory installed damper blade position end switches.

2.09 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.; Mestek, Inc
2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. General Description: Combination fire and smoke dampers shall be labeled according to UL 555 and UL 555S. Leakage shall not exceed 10 cfm per square foot at 1 inch WG differential pressure (Leakage Class II).

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.

E. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.

F. Mounting Sleeve: Factory-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Damper Actuators: Electric modulating or two-position action as required.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

2. Size for torque required for damper seal at load conditions.

3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.

4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (coordinate with Controls contractor).

6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.

7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.

8. Actuator timing shall meet 15 sec.

9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.

I. Manual Heat Responsive Fuse Link with Reset and Damper Blade Position End Switches: Factory installed manual heat responsive fuse link with reset switch / damper position switch package for both full open and full closed indication (equivalent to Ruskin TS150 switch package).

J. Test Switch: Damper mounted momentary “test” push-button switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.

1. Include damper mounted “open” and “closed” indication lights on switch plate for connection to factory installed damper blade position end switches.

2.10 DUCT SILENCERS (FIBERGLASS FILL)

A. Manufacturers:

1. IAC Acoustics; a Division of Sound Seal.

2. Price Industries.

3. Ruskin Company.

4. VAW Systems Ltd.

5. Vibro-Acoustics; A Swegon Group Company.

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 according to ASTM E 84.

C. Rectangular Units: Unless otherwise scheduled on the Drawings, fabricate casings with a minimum of 20 gage, solid galvanized sheet metal for outer casing and 22 gage, ASTM A 653/A 653M, G90, perforated galvanized sheet metal for inner casing.

D. Round Units: Unless otherwise scheduled on the Drawings:

1. Outer Casings:

a. ASTM A 653/A 653M, G90, galvanized sheet steel.

b. Up to 8 Inches in Diameter: 24 gage.

c. 9 through 22 Inches in Diameter: 22 gage.

d. 24 through 36 Inches in Diameter: 20 gage.

e. 38 through 50 Inches in Diameter: 18 gage.

f. 52 through 60 Inches in Diameter: 16 gage.

g. Casings fabricated of spiral lock-seam duct may be one gage thinner than that indicated.

2. Interior Casing, Partitions, and Baffles:

a. ASTM A 653/A 653M, G90, galvanized sheet steel, or aluminum to match duct system material.

b. At least 24 gage thick and designed for minimum aerodynamic losses.

E. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

F. Fill Material: Inert and vermin-proof fibrous glass material, packed under not less than 5 percent compression.

G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.

1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.

2. Lock form and seal or continuously weld joints.

3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.

4. Reinforcement: Cross or trapeze angles for rigid suspension.

H. Source Quality Control:

1. Acoustic Performance: Test according to ASTM E 477.

a. Tests performed in NVLAP accredited laboratory.

b. Include accreditation certificate with submittals.

c. Submittals from non-NVLAP accredited facilities will not be accepted.

2. Record acoustic ratings, including dynamic insertion loss and self-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.

2.11 TURNING VANES

A. Manufactured Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.

3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.

4. Manufacturers:

a. Aero-Dyne Sound Control; H-E-P Turning Vanes & Rail.

b. Ductmate Industries, Inc.

c. Duro Dyne Corporation.

d. Ward Industries, Inc.; a JCI Company.

B. Manufactured Acoustic Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.

3. Manufacturers:

a. Ductmate Industries, Inc.

b. Ward Industries, Inc.; a JCI Company.

2.12 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:

a. Air Balance, Inc.; Mestek, Inc.

b. Greenheck Gan Corporation.

c. Nailor Industries Inc.

d. Ruskin Company.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Provide number of hinges and locks as follows:

a. Less Than 12 Inches Square: Secure with two sash locks.

b. Up to 18 Inches Square: Two hinges and two compression locks.

c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.

d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.

1. Manufacturers:

a. Ductmate Industries, Inc.

b. Flexmaster U.S.A.; a Masterduct Company.

2. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.13 GREASE DUCT ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.

2. Flame Gard Inc.
3. 3M.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall personnel and maintenance access doors tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.

1. Construction: 0.0625 inch ASTM A 666, Type 304 stainless-steel inner shell; and aluminized-steel indoor or stainless-steel outdoor outer cover with two handles.
2. Fasteners: Stainless-steel bolts and wing nuts.
   a. Ensure that bolts do not penetrate interior of duct space.
3. Maintenance Access Door Dimensions: Minimum 7 x 7 inches.
4. Personnel Access Door Dimensions: Minimum 24 x 24 inches.
5. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

C. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

D. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.14 FLEXIBLE CONNECTORS

A. Manufacturers:

1. ADSCO Manufacturing LLC.
2. Duro Dyne Corp.
3. Senior Flexonics Pathway.
4. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 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. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 20 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.15 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

A. Manufacturers:

1. Flexmaster U.S.A.; a Masterduct Company; Type 1M Acoustical.
2. Hart & Cooley.
3. Thermaflex; part of the Flexible Technologies Group.

B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.

C. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F.

D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:
The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self-generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.

F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.16 FLEXIBLE DUCT ELBOW SUPPORTS

A. Manufacturer:

1. Titus; Air Distribution Technologies, Inc.; a JCI Company; FlexRight.
2. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
3. Hart and Cooley, Inc.; Smart Flow Elbow.

B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.

C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.17 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.18 **FINISHES**

A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 EXECUTION

3.01 **APPLICATION AND INSTALLATION**

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide 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 PVC coated ducts; and aluminum accessories in aluminum ducts.

C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install stainless steel volume dampers in stainless steel ducts.
3. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install fire dampers, combination fire and smoke dampers, and smoke dampers according to UL listing.

G. Install duct silencers rigidly to ducts.

H. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On upstream side of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans.
5. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
7. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
8. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.

K. Install pressure relief doors vertically and level in accordance with manufacturer’s instructions, between the fan and first operable damper.

L. Label access doors according to Division 20 Section "Mechanical Identification."

M. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

N. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

P. Connect diffusers or light troffer boots to low pressure ducts flexible duct clamped or strapped in place.

Q. Connect flexible ducts to metal ducts with plenum-rated draw bands.

R. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.

S. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:

1. Use manufactured double-vane turning vanes unless otherwise specified.
2. Seat outboard-most vane in heal of duct elbow.
3. Provide vanes for all runner punchings. Practice of eliminating every other vane is prohibited.
4. Use single-vane turning vanes in low pressure square elbows.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

3.03 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire dampers, combination fire and smoke dampers, and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3423 - POWER VENTILATORS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 PERFORMANCE REQUIREMENTS 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 2
1.05 CLOSEOUT SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
1.07 DELIVERY, STORAGE, AND HANDLING 2
1.08 COORDINATION 2
1.09 EXTRA MATERIALS 3
PART 2 PRODUCTS 3
2.01 CENTRIFUGAL ROOF VENTILATORS 3
2.02 ROOF CURBS AND ACCESSORIES 3
2.03 MOTORS 4
2.04 SOURCE QUALITY CONTROL 4
PART 3 EXECUTION 5
3.01 INSTALLATION 5
3.02 CONNECTIONS 5
3.03 FIELD QUALITY CONTROL 5
3.04 ADJUSTING 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Motors.”
3. Division 20 Section “Variable Frequency Controllers.”
4. Division 23 Section “Common Work Results for HVAC” for common mechanical drive requirements for fans and air moving equipment.

1.02 PERFORMANCE REQUIREMENTS

A. Classify according to AMCA 99.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.05 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 **COORDINATION**

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

1.09 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-drive unit.

PART 2 PRODUCTS

2.01 **CENTRIFUGAL ROOF VENTILATORS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing; Acme Fan Group; Models PRN and PV.
2. Twin City Fan Company.
3. Greenheck Fan Corporation; Models G.
4. Loren Cook Company; Models ACED and ACES.
5. Moffitt Corporation.
6. PennBarry; Domex.
7. Soler & Palau.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Sheaves: Cast-iron, adjustable-pitch motor sheave.
4. Fan and motor isolated from exhaust airstream.
5. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

F. Accessories:

1. Variable Frequency Controller: Refer to Division 20 Section “Variable Frequency Controllers.”
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

G. Provide prefabricated roof curbs for each fan.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.02 **ROOF CURBS AND ACCESSORIES**

A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:

a. Creative Metals.
b. The Pate Company.
c. Roof Products & Systems.
d. Thybar Corporation.
e. Any of the approved roof mounted exhaust fan manufacturers.

2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.
3. Height: Curb shall extend a minimum 8 inches above top surface of roof insulation.
4. Sound Curb: Curb with sound-absorbing insulation matrix.
5. Metal Liner: Galvanized steel.
6. Burglar Bars: Minimum 1/2-inch- thick steel bars welded in place to form 6-inch squares.
7. Mounting Pedestal: Galvanized steel with removable access panel.

B. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
a. Creative Metals.
b. The Pate Company.
c. Roof Products & Systems.
d. Thybar Corporation.
e. Any of the approved roof mounted exhaust fan manufacturers.
2. Configuration: Built-in raised cant with step dimension matching insulation thickness, with mounting flange, and suitable for sloped roofs with uniform insulation thickness.
3. Height: Curb shall extend a minimum 8 inches above top surface of roof insulation.
4. Sound Curb: Curb with sound-absorbing insulation matrix.
5. Pitch Mounting: Manufacture curb for roof slope, top of curb shall be level.
6. Metal Liner: Galvanized steel.
7. Burglar Bars: Minimum 1/2-inch- thick steel bars welded in place to form 6-inch squares.
8. Mounting Pedestal: Galvanized steel with removable access panel.

2.03 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

2.04 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 INSTALLATION

A. Install power ventilators level and plumb.

B. Install floor-mounting units as specified in Division 20 Section "Mechanical Vibration Controls."

C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. 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.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 **ADJUSTING**

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor sheaves as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 23 3600 - AIR TERMINAL UNITS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
1.03 INFORMATIONAL SUBMITTALS 1
1.04 CLOSEOUT SUBMITTALS 2
1.05 QUALITY ASSURANCE 2
1.06 COORDINATION 2
1.07 EXTRA MATERIALS 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 SINGLE-DUCT AIR TERMINAL UNITS 2
2.03 HANGERS AND SUPPORTS 3
2.04 SOURCE QUALITY CONTROL 3
PART 3 EXECUTION 3
3.01 INSTALLATION 3
3.02 HANGER AND SUPPORT INSTALLATION 3
3.03 CONNECTIONS 4
3.04 FIELD QUALITY CONTROL 4
3.05 STARTUP SERVICE 4
3.06 DEMONSTRATION 5

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section “Metal Ducts.”
3. Division 23 Section “Temperature Controls.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Liners and adhesives.
2. Sealants and gaskets.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
2. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.04 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For air terminal units to include in operation and maintenance manuals. Include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.05 **QUALITY ASSURANCE**

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.06 **COORDINATION**

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.07 **EXTRA MATERIALS**

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **SINGLE-DUCT AIR TERMINAL UNITS**

A. Manufacturers:

1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
2. Nailor Industries, Inc.
3. Price Industries.
4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.

B. Configuration: Variable and constant volume, medium pressure terminal units with casing, 24 volt control transformer, electrical service disconnect switch, 100 percent tight shutoff volume regulator, velocity sensor, and sound attenuating thermal insulation.

C. Casing: Constructed of 0.034-inch mill galvanized steel or 0.032-inch aluminum.

1. Casing Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Velocity Sensor: Multipoint averaging array. Sensor located in air inlet.

F. Attenuator Section: 0.034-inch mill galvanized steel or 0.032-inch aluminum sheet metal.

1. Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.

G. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig and factory installed.

H. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Temperature Controls."

I. Control Sequence: Refer to Temperature Control Diagrams on Drawings.

2.03 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Steel Cables: Galvanized steel complying with ASTM A 603.

C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.04 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

B. Verification of Performance: Rate air terminal units according to AHRI 880.

C. Acoustical Applications and Sound Evaluation: Based on AHRI Standard 885-98, “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.”

PART 3 EXECUTION

3.01 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.02 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached. Refer to Division 20 Section “Hangers and Supports” for additional information.

1. Where practical, install concrete inserts before placing concrete.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot Water Piping: Unless otherwise indicated:

1. Install union and isolation valve on supply-water connection.

2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.

3. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

E. Ground units with electric heating coils according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.

2. Verify that controls and control enclosure are accessible.

3. Verify that control connections are complete.

4. Verify that nameplate and identification tag are visible.

5. Verify that controls respond to inputs as specified.

3.06 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
1.03 INFORMATIONAL SUBMITTALS 1
PART 2 PRODUCTS 1
2.01 AIR DIFFUSION DEVICES 1
2.02 SOURCE QUALITY CONTROL 2
PART 3 EXECUTION 2
3.01 EXAMINATION 2
3.02 INSTALLATION 2
3.03 ADJUSTING 2

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.02 ACTION SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

PART 2 PRODUCTS

2.01 AIR DIFFUSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
2. Nailor Industries, Inc.
3. Price Industries.
4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.

B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.

C. Provide plaster frames for units installed in plaster ceilings.

D. Provide gaskets for supply terminal air devices mounted in finished surfaces.

E. Finish:

1. Device Face and Visible Trim: Standard off white baked enamel finish unless noted otherwise.
2. Device Interior Surfaces, Including Blank-Offs and Boots: Black matte finish.

F. Air pattern adjustments shall be made from the face of the device.

G. Refer to drawings and schedules for quantities, types, and finishes.

H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.02 **SOURCE QUALITY CONTROL**

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.”

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. 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. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 **ADJUSTING**

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 8229 - ELECTRIC AND HYDRONIC RADIANT HEATING UNITS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 DEFINITIONS 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 1
1.05 CLOSEOUT SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
1.07 COORDINATION 2
PART 2 PRODUCTS 2
2.01 ELECTRIC RADIANT HEATING PANELS 2
PART 3 EXECUTION 3
3.01 EXAMINATION 3
3.02 INSTALLATION 3
3.03 CONNECTIONS 3
3.04 FIELD QUALITY CONTROL 4
3.05 DEMONSTRATION 4

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Chilled Beams.”

1.02 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, specialties, and accessories for each product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which heaters and suspension systems will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

5. Perimeter moldings.

1.05 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For electric radiant heaters and panels to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1.07 **COORDINATION**

A. Coordinate layout and installation of radiant heaters and panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.01 **ELECTRIC RADIANT HEATING PANELS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko Electric Heating; a division of Marley Engineered Products.
2. Markel Products; a division of TPI Corporation.
3. QMark Electric Heating; a division of Marley Engineered Products.

B. Description: Sheet-metal-enclosed panel with heating element suitable for installation flush with T-bar ceiling grid recessed mounting. Comply with UL 2021.

1. Panel: Minimum 0.0276-inch thick, galvanized-steel sheet back panel riveted to minimum 0.0396-inch- thick, galvanized-steel sheet front panel with fused-on crystalline surface.
2. Heating Element: Powdered graphite sandwiched between sheets of electric insulation.
3. Heating Element: Insulated resistive wires.
4. Electrical Connections: Nonheating, high-temperature, insulated-copper leads, factory connected to heating element.
5. Exposed-Side Panel Finish: Apply silk-screened finish to match appearance of Architect-selected acoustical ceiling tiles.
6. Exposed-Side Panel Finish: Factory prime coated, ready for field painting.
7. Exposed-Side Panel Finish: Baked-enamel finish in manufacturer's standard paint color as selected by Architect.

C. Wall Thermostat: Bimetal, sensing elements calibrated from 55 to 90 deg F; with contacts suitable for low-voltage circuit, and manually operated on-off switch with contactors, relays, and control transformers.

D. Capacities and Characteristics: Refer to Schedules on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive radiant heating and cooling units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before radiant heating and cooling unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install radiant heating units level and plumb.

B. The linear radiant and matching non-radiant panels shall be installed by manufacturer's authorized Radiant Ceiling Contractor. Contractor shall install all panels in accordance with the manufacturer's recommendations.

C. The installation of the radiant panel ceiling and matching non-radiant (inactive) panels shall be made by a single Radiant Ceiling Sub-Contractor experienced in this work. The subcontractor shall provide labor, materials, equipment, and supervision for a complete and operational system. Sub-Contractor shall submit certification of having a minimum of two (2) years previous experience in radiant ceiling installations.

1. Contractor shall provide all necessary wall channels, angles and required support for radiant panel. Contractor shall provide tee sections between adjacent panels and at panel ends. Contractor shall verify ceiling openings are large enough to accommodate thermal expansion and contraction of ceiling panels. The ceiling contractor shall provide and install the tee between the acoustical ceiling and the radiant panel along the length of the panel.

D. Radiant ceiling panel suspension shall be independent of the ceiling system.

E. Hangers shall be installed as recommended by the manufacturer.

F. Contractor shall integrate and coordinate radiant ceiling panel installation with ceiling grid installation (by others).

G. The Radiant Ceiling Sub-Contractor shall cooperate with other trades working in the ceiling to achieve a neat, well coordinated, and properly sequenced overall installation.

H. Work of Radiant Ceiling Sub-contractor shall terminate within three feet of the supply and return point of each panel circuit.

I. The Radiant Ceiling Sub-Contractor shall furnish and install all necessary piping and bends required for the interconnection of the panel sections. The panel interconnecting pipe and bends shall be furnished by the panel manufacturer and shall provide for necessary expansion and contraction as recommended by the manufacturer.

J. All installation of linear panels, where made with mitered joints, shall be made so that the fluting on the abutting panel is aligned.

K. Verify locations of thermostats with Drawings and room details before installation. Install devices 48 inches above finished floor.

3.03 CONNECTIONS

A. Ground electric units according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 **FIELD QUALITY CONTROL**

A. Testing: Perform the following field tests and inspections and prepare test reports:

1. Operate electric heating elements through each stage to verify proper operation and electrical connections.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and units.

B. Remove and replace malfunctioning units and retest as specified above.

C. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.05 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain radiant heaters and panels.

END OF SECTION

SECTION 23 8233 - CONVECTION HEATING UNITS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
1.03 INFORMATIONAL SUBMITTALS 1
1.04 CLOSEOUT SUBMITTALS 1
1.05 QUALITY ASSURANCE 1
PART 2 PRODUCTS 2
2.01 PANEL (FLAT-PIPE STEEL) RADIATORS 2
PART 3 EXECUTION 2
3.01 EXAMINATION 2
3.02 FLAT-PIPE STEEL RADIATOR INSTALLATION 2
3.03 CONNECTIONS 2
3.04 FIELD QUALITY CONTROL 3

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Location and arrangement of integral controls.
2. Enclosure joints, corner pieces, access doors, and other accessories.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Structural members, including wall construction, to which convection units will be attached.
5. Method of attaching convection units to building structure.
6. Penetrations of fire-rated wall and floor assemblies.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For convection heating units to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

2.01 PANEL (FLAT-PIPE STEEL) RADIATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Runtal North America, Inc.; A Zehnder Group Company.

B. Heating Elements: Steel, welded and formed into flat, square, steel header with minimum thickness of 0.109 inches. Include threaded piping and air vent connections.

1. Standard: Working Pressure 56 psig maximum. Test Pressure 74 psig maximum.

C. Mounting: Wall brackets on maximum spacing of 36 inches

D. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.

E. Accessories:

1. Steel piping covers finished to match radiator finish.
2. Flexible Expansion Compensation Hoses: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F.
    a. Minimum Diameter: Equal to connection size.
3. Integral heavy-gage steel, all-welded top grille.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive convection heating units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before convection heating unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FLAT-PIPE STEEL RADIATOR INSTALLATION

A. Install units level and plumb.

B. Install expansion compensation hoses.

C. Install piping covers.

3.03 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section Hydronic Piping Drawings indicate general arrangement of piping, fittings, and specialties.

B. Hot Water Piping: Unless otherwise indicated:

1. Install union and isolation valve on supply-water connection.
2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.
3. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

C. Install control valves as required by Division 23 Section "Temperature Controls."

D. Install piping adjacent to convection heating units to allow service and maintenance.

3.04 **FIELD QUALITY CONTROL**

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper convection heating unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace convection heating units that do not pass tests and inspections and retest as specified above.

END OF SECTION

SECTION 23 8240 - CENTRIFUGAL FAN CABINET UNIT HEATERS (HOT WATER)

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
1.03 INFORMATIONAL SUBMITTALS 1
1.04 CLOSEOUT SUBMITTALS 2
1.05 QUALITY ASSURANCE 2
1.06 EXTRA MATERIALS 2
PART 2 PRODUCTS 2
2.01 MANUFACTURED UNITS 2
2.02 UNIT CONTROLS 3
PART 3 EXECUTION 3
3.01 EXAMINATION 3
3.02 INSTALLATION 3
3.03 CONNECTIONS 4
3.04 FIELD QUALITY CONTROL 4
3.05 DEMONSTRATION 4

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Location and arrangement of piping valves and specialties.
4. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
6. Perimeter moldings for exposed or partially exposed cabinets.

1.04 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For cabinet unit heaters to include in operation and maintenance manuals.

1.05 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

1.06 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Furnish spare filter for each filter installed.

PART 2 PRODUCTS

2.01 **MANUFACTURED UNITS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; United Technologies Corporation.
2. Daikin Applied; a member of Daikin Industries, Ltd.
3. Hydro-Air Components Inc.; Zehnder Rittling.
4. Modine Manufacturing Company.
5. Sterling Radiator; a Mestek Company.
6. Trane; a Trane Technologies Brand.
7. Vulcan Radiator; a Mestek Company.

B. Description: A factory-assembled and -tested unit complying with AHRI 440.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall have erosion-resistant coating to prevent erosion of glass fibers.

1. Thickness: Minimum 1/2 inch.
2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.

1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

2. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.

3. Recessing Flanges for Units That Are Semirecessed or Fully Recessed: Steel, finished to match cabinet.

4. Control Access Door: Key operated.

5. Base for Surface, Vertical, Wall-Mounting Units: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.

E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber Treated with Adhesive: Throw-away type 80 percent arrestance and 5 MERV.

F. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

G. Fan and Motor Board: Removable.

1. Fan: Forward curved, double-width centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 20 Section "Motors."

3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Electrical Connection: Factory wire motors and controls for a single field connection.

I. Capacities and Characteristics: Refer to Schedule on Drawings.

2.02 **UNIT CONTROLS**

A. Control devices are specified in Division 23 Section "Temperature Controls," and operational sequences are indicated on the Drawings.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before cabinet unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Suspend cabinet unit heaters from structure with elastomeric hangers.

1. Vibration isolators are specified in Division 20 Section "Mechanical Vibration and Controls."

C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Comply with safety requirements in UL 1995.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.05 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

SECTION 26 0010 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 REFERENCES 1
1.04 QUALITY ASSURANCE 2
1.05 CODES, PERMITS AND FEES 2
1.06 DRAWINGS 3
1.07 MATERIAL AND EQUIPMENT MANUFACTURERS 3
1.08 INSPECTION OF SITE 3
1.09 ITEMS REQUIRING PRIOR APPROVAL 3
1.10 SHOP DRAWINGS/SUBMITTALS 4
1.11 COORDINATION DRAWINGS 4
1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS 4
1.13 RECORD DRAWINGS 5
1.14 INSTRUCTION OF OWNER PERSONNEL 5
1.15 WARRANTY 5
1.16 USE OF EQUIPMENT 5
1.17 COORDINATION 5

PART 2 PRODUCTS (NOT APPLICABLE) 6

PART 3 EXECUTION 6
3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION 6
3.02 DEMOLITION WORK 6
3.03 INSTALLATION OF EQUIPMENT 7
3.04 WORK IN EXISTING BUILDINGS 7
3.05 TEMPORARY SERVICES 8
3.06 DISPOSAL 8
3.07 CHASES AND RECESSES 8
3.08 CUTTING, PATCHING AND DAMAGE TO OTHER WORK 8
3.09 EXCAVATION AND BACKFILLING 8
3.10 EQUIPMENT CONNECTIONS 9
3.11 CLEANING 9
3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS 9
3.13 EXTRA WORK 9
3.14 DRAWINGS AND MEASUREMENTS 9

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 SUMMARY

A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. ANSI - American National Standards Institute; www.ansi.org.

2. ASTM - ASTM International; www.astm.org.
3. CSI - Construction Specifications Institute (The); www.csiresources.org.
4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
6. NEC - National Electrical Code
7. NECA - National Electrical Contractors Association; www.necanet.org.
   a. NECA 1-2000, “Practices for Good Workmanship in Electrical Contracting (ANSI).”
8. NEMA - National Electrical Manufacturers Association; www.nema.org.
9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
10. UL - Underwriters Laboratories Inc.; www.ul.com.

1.04 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.

1. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
2. The Contractor understands that the work herein described shall be complete in every detail.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State, and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.

1. Notify the Architect/Engineer if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.

C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county, and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Avoid interference with the work of other trades. Remove and relocate any work which in the opinion of the Owner’s Representatives causes interference.

1.05 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals, and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules, and regulations.

B. Comply with rules of local utility companies. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets, and meters which will be required and include the cost of all such items and all utilities costs in proposal.

C. All work shall be executed in accordance with the rules and regulations outlined in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing

authorities. Where the Drawings and/or Specifications indicate materials or construction that exceed code requirements, the Drawings and/or Specifications shall govern.

1.06 **DRAWINGS**

A. The Drawings show the location and general arrangement of equipment, electrical systems, and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes, and accessories as may be required to meet such conditions.

C. Deviations from the Drawings, apart from minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades, and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.07 **MATERIAL AND EQUIPMENT MANUFACTURERS**

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new, be standard products of manufacturers regularly engaged in the production of electrical equipment and be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

C. Where existing equipment is modified to include new switches, circuit breakers, metering, or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third-party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.08 **INSPECTION OF SITE**

A. Visit the site, examine, and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.09 **ITEMS REQUIRING PRIOR APPROVAL**

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1

specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information, and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. Provide detailed layout shop Drawings on electronic media of all lighting and power distribution systems, routing of conduits, combining of circuits, circuiting, details, and related information necessary for installation and maintenance. After review by the Architect/Engineer, electronic Drawings will be stamped and returned to the Contractor.

D. If deviations (not substitutions) from the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included with the submittal for approval.

E. Submit for approval shop drawings for electrical systems or equipment indicated in other sections of electrical specs. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures).

1.11 COORDINATION DRAWINGS

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:

1. Routine maintenance procedures.
2. Trouble-shooting procedures.
3. Contractor's telephone numbers for warranty repair service.

4. Submittals.
5. Recommended spare parts list.
6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 **RECORD DRAWINGS**

A. Submit record drawings in compliance with Division 01.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be marked with a contrasting color so the marks are readily apparent.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer, and Owner at their request during construction.

1.14 **INSTRUCTION OF OWNER PERSONNEL**

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.

D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 **WARRANTY**

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship, or failure to follow the contract documents.

B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 **USE OF EQUIPMENT**

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 **COORDINATION**

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 **DEMOLITION WORK**

A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items related to the existing systems that are being removed such as, but not limited to, electrical equipment, cabinets, devices, lighting fixtures, conduit, fittings, boxes, wiring, and supports. No abandoned components of the electrical systems indicated to be removed shall remain.

1. Where electrically powered equipment is included in the demolition scope of other trades, disconnect electrical wiring connections and remove circuit wiring complete.

B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.

C. Unless specifically noted otherwise, removed materials shall not be reused in the work.

1. Materials indicated to be salvaged shall be carefully removed, stored, and protected from damage.
2. Salvaged materials intended to be re-used shall be thoroughly cleaned, refurbished if necessary, and determined to be fully functional prior to placing back into service.
3. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items that the Owner has waived ownership shall

become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

D. Where equipment or fixtures are removed, outlet boxes that remain recessed in walls shall be properly blanked off, and conduits capped. After alterations are complete, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical systems remaining in service shall not be changed unless specifically indicated as part of the project scope.

E. Reroute signal wires, lighting, and power wiring as required to maintain services that are to remain and/or unaffected by the renovations. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or the panels.

F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.

G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where specifically indicated on the drawings or approved by the Architect/Engineer.

H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, re-lamped, and reconditioned suitable for satisfactory operation and appearance.

3.03 **INSTALLATION OF EQUIPMENT**

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Device Location:

1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10’ radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.

3.04 **WORK IN EXISTING BUILDINGS**

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal, or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.05 **TEMPORARY SERVICES**

A. Provide and remove upon completion of the project, following the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.06 **DISPOSAL**

A. Fluorescent Lamps

1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location before transportation.
3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
4. Upon completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state, and federal guidelines.

B. Ballasts

1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state, and federal guidelines.

3.07 **CHASES AND RECESSES**

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.08 **CUTTING, PATCHING AND DAMAGE TO OTHER WORK**

A. Refer to General Conditions for requirements.

B. All cutting, patching, and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.09 **EXCAVATION AND BACKFILLING**

A. Provide all excavation, trenching, tunneling, dewatering, and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.

C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

D. Backfill all excavations inside building, under drives, and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen excavated material in such a way as to prevent settling.

3.10 EQUIPMENT CONNECTIONS

A. Make connections to equipment and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.11 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury, or damage.

B. Protect conduit openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.13 EXTRA WORK

A. For additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.

3.14 DRAWINGS AND MEASUREMENTS

A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor’s responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION

SECTION 26 0519 - CONDUCTORS AND CABLES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 1
1.05 QUALITY ASSURANCE 1
PART 2 PRODUCTS 2
2.01 COPPER BUILDING WIRE 2
2.02 ALUMINUM BUILDING WIRE 2
2.03 METAL-CLAD CABLE, TYPE MC 2
2.04 CONNECTORS AND SPLICES 3
PART 3 EXECUTION 3
3.01 CONDUCTOR MATERIAL APPLICATIONS 3
3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS 3
3.03 INSTALLATION OF CONDUCTORS AND CABLES 4
3.04 CONNECTIONS 4
3.05 IDENTIFICATION 5
3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS 5
3.07 FIRESTOPPING 5
3.08 FIELD QUALITY CONTROL 5

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Building wires and cables rated 600V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.03 ACTION SUBMITTALS

A. Submit letter of compliance (intent) for copper and aluminum building wire.

B. Provide product data for the following:

1. Metal-Clad Cable, Type MC

1.04 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Test Reports.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type THHN/THWN-2: Comply with UL 83.
2. Type THW/THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.02 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.

1. Allowed only for conductors used in feeders 100A and larger.

B. Manufacturers:

1. General Cable
2. Southwire

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.

E. Conductor Insulation:

1. Type XHHW-2: Comply with UL 44.

2.03 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers:

1. AFC Cable Systems
2. Alpha Wire Company
3. American Bare Conductor
4. Belden
5. Encore
6. General Cable

7. Okonite
8. Service Wire Co.
9. Southwire Company

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors for branch circuit distribution.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors:

1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated. Ground conductor sized as indicated on drawings (reduced ground conductor is not acceptable).

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Aluminum, interlocked.

2.04 **CONNECTORS AND SPLICES**

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.01 **CONDUCTOR MATERIAL APPLICATIONS**

A. Refer to application schedule on the drawings

B. If providing aluminum feeders, contractor is responsible to provide calculations for engineer to review prior to installation. Calculations to include voltage drop, equipment ground size, conduit size and any de-rating required.

C. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

D. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).

E. Use conductor not smaller than 14 AWG for 120V control circuits.

F. Where equipment is listed for use with copper conductors only, use copper conductors for the entire length of feeder.

3.02 **CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

A. Refer to application schedule on the drawings

B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 26 0536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

I. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.

J. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable. Neutral conductors shall be considered current carrying conductors.

K. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction.

L. MC cable shall not be used for home runs to receptacle or distribution panels.

M. Where MC cable is permitted by the specifications, MC cable shall not be bundled.

N. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

O. Do not route conductors across roof without prior approval from engineer.

3.04 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 and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

2. Use compression type terminations for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Clean conductor surfaces before installing lugs and connectors.

E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.

G. Use piercing connector with insulating covers for conductor splices and taps, 8 AWG and larger only for taps to existing feeders. Do not use piercing connectors in new construction.

H. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.

I. Use insulated spring wire connectors with plastic caps (wire nuts) for copper conductor splices and taps, 10 AWG and smaller. Push-in style connectors are not permitted.

J. Provide lugs suitable for bussing and conductor material used.

K. Use appropriately sized compression pin adapters to make terminations at equipment where equipment lugs cannot accommodate conductors that are oversized for voltage drop or similar conditions.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 0533 "Raceways and Boxes."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping”.

3.08 FIELD QUALITY CONTROL

A. Perform the following field quality control tests in accordance with Division 26 Section “Electrical Testing”.

1. Description: Test all feeders rated 100 A and above.
2. Visual and Mechanical Inspection
    a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
    b. Test cable mechanical connections with an infrared survey.
    c. Check cable color-coding against project Specifications and N.E.C. requirements.
3. Electrical Tests
    a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
    b. Perform continuity test to insure proper cable connection.
4. Test Values
    a. Minimum insulation resistance values shall be not less than fifty mega-ohms.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 REFERENCES 1
1.04 INFORMATIONAL SUBMITTALS 2
1.05 CLOSEOUT SUBMITTALS 2
1.06 QUALITY ASSURANCE 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 GROUNDING CONDUCTORS 3
2.03 CONNECTOR PRODUCTS 3
2.04 GROUNDING ELECTRODES 3
PART 3 EXECUTION 4
3.01 EQUIPMENT GROUNDING 4
3.02 CONNECTIONS 4
3.03 INSTALLATION 5
3.04 TELECOMMUNICATIONS GROUNDING 6
3.05 FIELD QUALITY CONTROL 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. Division 26 Section “Conductors and Cables”.

1.03 REFERENCES

A. ASTM B 3: Specification for Soft or Annealed Copper Wire.

B. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

C. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.

D. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

E. IEEE 142: Grounding of Industrial and Commercial Power Systems.

F. IEEE 837: Qualifying Permanent Connections Used in Substation Grounding.

G. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

H. IEEE C2: National Electrical Safety Code.

I. NETA MTS – 2001: Maintenance Testing Specifications.

J. NFPA 70: National Electrical Code.

K. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.

L. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.

M. UL 467: Grounding and Bonding Equipment.

N. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

O. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.04 **INFORMATIONAL SUBMITTALS**

A. Field Quality Control Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
4. Indicate overall system resistance to ground.
5. Indicate overall Telecommunications system resistance to ground.

1.05 **CLOSEOUT SUBMITTALS**

A. Project Record Documents

1. Submit under provisions of Division 26 “Electrical General Requirements”.
2. Accurately record actual locations of grounding electrodes and connections to building steel.

1.06 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

D. Comply with ANSI/TIA/EIA-607 “Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications”.

E. Comply with ANSI/IEEE 1100 -1992 “Powering and Grounding Sensitive Electronic Equipment”.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors and Cables:
   a. Refer to Division 26 Section “Conductors and Cables”.
2. Grounding Rods:
   a. American Electric-Blackburn.
   b. Apache Grounding/Erico Inc.
   c. Chance/Hubbell.
3. Mechanical Connectors:

a. American Electric-Blackburn.

b. Burndy.

c. Chance/Hubbell.

4. Exothermic Connections:

a. Cadweld.

5. Compression-type Connectors:

a. Burndy HyGround

b. Blackburn EZ Ground.

c. Panduit.

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."

B. Material: Aluminum, copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.

2. Assembly of Stranded Conductors: ASTM B 8.

G. Copper Bonding Conductors: As follows:

1. Bonding Conductor: Stranded copper conductor; size per the NEC.

2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.

3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.

H. Telecommunications Bonding Backbone (TBB)

1. Minimum No. 2 AWG insulated stranded copper.

I. Telecommunications Bonding Conductors

1. Minimum No. 6 AWG insulated stranded copper.

2.03 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.

D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.

1. Size: 5/8 in diameter.

2. Length: 120 inches.

PART 3 EXECUTION

3.01 **EQUIPMENT GROUNDING**

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

D. In raceways, use insulated equipment grounding conductors. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

1. Where existing branch circuits are using conduit as equipment grounding conductor and are extended, provide grounding bushing on existing conduit and provide new equipment grounding conductor with new branch circuit.

E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

G. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

H. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.

J. Verify specific equipment grounding requirements with the manufacturer’s recommendations.

3.02 **CONNECTIONS**

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations

1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.

2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding 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.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Connections shall be non-reversible. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.03 **INSTALLATION**

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.

1. Aluminum and copper-clad aluminum conductors shall not be used in direct contact with masonry, within 18 inches of the earth, or where subject to corrosive conditions.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors or non-reversing compression-type connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

C. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

D. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

E. Bond interior metal piping systems, including any portions of metal piping systems separated by non-metal piping, and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

F. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.

G. Bond together metal building elements not attached to grounded structure; bond to ground.

3.04 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:

1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main building electrical grounding electrode system via a No. 3/0 AWG copper ground conductor.
2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.
3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.
4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB's or TMGB using approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

B. All bonding connections shall be installed at an accessible location for inspection and maintenance.

C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.

D. The physical routing shall, in general, follow the same path as the backbone cable system.

E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.

F. Do not use TGB's as a power system ground connection unless specifically noted on the Drawings.

G. All bonding connectors and conductors shall be UL listed for the purpose intended.

H. TMGB and TGB installation: Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.

I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.

J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB's to TBB with bare No. 3/0 AWG copper ground conductor and T-tap grounding hardware.

3.05 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 PERFORMANCE REQUIREMENTS 1
1.05 QUALITY ASSURANCE 2
1.06 COORDINATION 2
PART 2 PRODUCTS 2
2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS 2
2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES 3
2.03 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS 3
2.04 BACKBOARDS 4
PART 3 EXECUTION 4
3.01 APPLICATION 4
3.02 SUPPORT INSTALLATION 4
3.03 INSTALLATION OF FABRICATED METAL SUPPORTS 5
3.04 INSTALLATION OF ROOF MOUNTED SUPPORTS 5
3.05 CONCRETE BASES 6
3.06 BACKBOARDS 6
3.07 PAINTING 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 **QUALITY ASSURANCE**

A. Comply with NFPA 70.

1.06 **COORDINATION**

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 **SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.

b. B-Line, by Eaton.

c. GS Metals Corp.

d. Pentair Electrical & Fastening Solutions.

e. Thomas & Betts Corporation.

f. Unistrut; a part of Atkore International.

g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti Inc.

2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3) MKT Fastening, LLC.

4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) B-Line by Eaton.

2) Empire Tool and Manufacturing Co., Inc.

3) Hilti Inc.

4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.03 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS

A. General: Shop- or field- fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted conduit and equipment.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-Line by Eaton; Dura-Blok.

2. MIRO Industries.

3. Pentair Electrical & Fastening Solutions; Caddy Pyramid.

4. Pipe Pier Support Systems; Pipe Piers.

C. Adjustable Compact Stand: Recycled rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various supporting elements.

D. Multiple-Conduit and Equipment Stand: Assembly of bases, vertical and horizontal members, and conduit supports, for roof installation without membrane penetration.

1. Bases: One or more adjustable compact stand bases.

2. Vertical Members: Two or more protective-coated-steel channels.

3. Horizontal Member: Protective-coated-steel channel.

4. Supports: Standard strut clamps, hangers, and accessories.

2.04 **BACKBOARDS**

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management and equipment racks.

PART 3 EXECUTION

3.01 **APPLICATION**

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with:

a. Two-bolt conduit clamps

D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

3.02 **SUPPORT INSTALLATION**

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel:

a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69

c. Spring-tension clamps.

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 support systems attached to substrate.

E. Slotted support systems applications:

1. Indoor dry and damp Locations: Galvanized Steel

2. Outdoors and interior wet locations: Galvanized Steel

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

G. Do not fasten supports to floor decks, roof decks, pipes, ducts, mechanical equipment, or conduit.

H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

I. Obtain permission from Architect/Engineer before drilling or cutting structural members.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.04 INSTALLATION OF ROOF MOUNTED SUPPORTS

A. Install in accordance with manufacturer’s instructions.

B. If gravel top roof, gravel must be removed around and under support.

C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.

D. Utilize properly sized clamps and accessories to suit conduit sizes.

E. Provide vertical steel channel members as required for elevated conduit supports where required for clearances, coordination with other roof mounted systems or derating.

3.05 **CONCRETE BASES**

A. Provide concrete bases for all floor mounted electrical equipment.

B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.

C. Base/Pad Construction:

1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.

2. Interior concrete bases shall have a minimum depth of 4" unless other indicated or recommended by the manufacturer.

3. Exterior concrete bases shall have a minimum depth of 8" unless other indicated or recommended by the manufacturer.

4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.

D. Anchor equipment to base per both supports and equipment manufacturer's instructions.

E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.

2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

3.06 **BACKBOARDS**

A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8'-6" above finished floor in all Telecommunication Rooms and similar spaces and as indicated on Drawings.

B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).

C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

3.07 **PAINTING**

A. Touchup: Comply with requirements in Division 09 Painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533 - RACEWAYS AND BOXES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 ACTION SUBMITTALS 2
1.05 QUALITY ASSURANCE 2
1.06 COORDINATION 2
PART 2 PRODUCTS 2
2.01 METAL CONDUIT AND TUBING 2
2.02 FIRE ALARM EMT 3
2.03 NONMETALLIC CONDUIT AND TUBING 3
2.04 METAL WIREWAYS 3
2.05 SURFACE RACEWAYS 4
2.06 BOXES, ENCLOSURES, AND CABINETS 4
2.07 SLEEVES FOR RACEWAYS 4
2.08 SLEEVE SEALS 4
2.09 GROUT 5
PART 3 EXECUTION 5
3.01 RACEWAY APPLICATION 5
3.02 INSTALLATION 5
3.03 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS 8
3.04 SLEEVE-SEAL INSTALLATION 9
3.05 FIRESTOPPING 9
3.06 PROTECTION 9
3.07 CLEANING 9

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 07 Section, “Penetration Firestopping” for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
2. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
3. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

H. PVC: Polyvinyl Chloride.

I. HDPE: High Density Polyethylene.

1.04 **ACTION SUBMITTALS**

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.06 **COORDINATION**

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.01 **METAL CONDUIT AND TUBING**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube Triangle Century.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. International Metal Hose.
6. Electri-Flex Co
7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
9. Maverick.
10. O-Z Gedney; unit of General Signal.
11. Wheatland.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. FMC: Aluminum.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Steel, set-screw type.

2.02 **FIRE ALARM EMT**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube Triangle Century.

B. EMT conduit with bright red topcoat; Fire Alarm EMT.

C. EMT and Fittings: ANSI C80.3.

2.03 **NONMETALLIC CONDUIT AND TUBING**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Condux International.
7. ElecSys, Inc.
8. Electri-Flex Co.
9. Integral.
10. Kor-Kap.
11. Lamson and Sessions: Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.
13. RACO; Division of Hubbell, Inc.
14. Scepter.
15. Spiralduct, Inc./AFC Cable Systems, Inc.
16. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

2.04 **METAL WIREWAYS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.05 **SURFACE RACEWAYS**

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).

b. Thomas & Betts Corporation.

c. Walker Systems, Inc.; Wiremold Company (The).

d. Wiremold Company (The); Electrical Sales Division.

e. Mono-Systems, Inc.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.06 **BOXES, ENCLOSURES, AND CABINETS**

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2. Shall be used in corrosive areas.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.

G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.07 **SLEEVES FOR RACEWAYS**

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.08 **SLEEVE SEALS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Plastic. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.09 **GROUT**

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.01 **RACEWAY APPLICATION**

A. Provide raceways in interior and exterior locations in accordance with the “Raceway Application Matrix” included on the drawings.

B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.

C. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

D. Minimum Raceway Size: 3/4-inch trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3. EMT: Use setscrew, cast-metal fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 **INSTALLATION**

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

J. Support conduit within 12 inches of enclosures to which attached.

K. Raceways Embedded in Slabs:

1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.

2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.

3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

4. Space raceways laterally to prevent voids in concrete.

5. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

7. Conduits shall run flat. Do not allow conduits to cross.

8. Change from non-metallic raceway to rigid steel before turning up out of the concrete and rising above the floor.

L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

U. Provide pull string and 25% spare capacity in every branch circuit conduit.

V. Communications and Signal Cabling Systems Raceways: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

1. Electrical condulet (LB’s) are not permitted.
2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
3. Conduits shall contain no continuous sections longer than 150 ft. without a pull point/box.
4. Conduit for fiber cabling shall have a bend radius of at least 10 times the internal diameter.
5. Conduit for copper cabling less than 2” shall have a bend radius of at least 6 times the internal diameter. Conduit for copper cabling 2” and larger shall have a bend radius of at least 10 times the internal diameter.
6. All conduit ends shall have an insulated bushing.

W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

X. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Z. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.

AA. 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.

BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

CC. Locate boxes so that cover or plate will not span different building finishes.

DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.

GG. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

HH. Do not route feeders across roof.

II. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.

JJ. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

3.03 **SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS**

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.04 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.05 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.06 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.07 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 ACTION SUBMITTALS 1
1.04 QUALITY ASSURANCE 1
1.05 COORDINATION 1
PART 2 PRODUCTS 2
2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS 2
2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS 2
2.03 WARNING LABELS AND SIGNS 2
2.04 EQUIPMENT IDENTIFICATION LABELS 2
2.05 MISCELLANEOUS IDENTIFICATION PRODUCTS 2
2.06 WIRING DEVICE IDENTIFICATION 3
PART 3 EXECUTION 3
3.01 APPLICATION 3
3.02 INSTALLATION 4

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Warning labels and signs.
4. Equipment identification labels.
5. Miscellaneous identification products.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.

2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.04 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.

B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.05 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.

2. Tensile Strength: 50 lb, minimum.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.06 **WIRING DEVICE IDENTIFICATION**

A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 EXECUTION

3.01 **APPLICATION**

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 400 A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.
2. Security System: Blue and yellow.
3. Telecommunication System: Green and yellow.
4. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.

E. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.

F. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.

b. Outdoor Equipment: Stenciled.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled: If included on project. All items may not be on project.

a. Panelboards, electrical cabinets, and enclosures.

b. Access doors and panels for concealed electrical items.

c. Electrical switchgear and switchboards.

d. Motor starters.

e. Fire-alarm control panel and annunciators.

f. Breakers or switches at distribution panels.

J. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

3.02 **INSTALLATION**

A. Verify identity of each item before installing identification products.

B. Location:

1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.

C. Apply identification devices to surfaces after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Grounded Conductor (Neutral): White.
3. Colors for 480/277-V Circuits:
    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Ground Conductor (Neutral): Grey.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Label information arrangement for 3 lines of text.
1. Line one shall describe the panel or equipment. Line one example: “DP-XX,” RP-XX,” “T-XX,” “EF-XX,” etc.
2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: “Fed from DP-XX,” “Fed from RP-XX,” etc.
3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: “First Floor Elect. Rm #XXX.”
4. Line four shall include “Via T-XX” when panel or equipment is fed from a transformer.

I. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100

J. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.

K. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

L. Degrease and clean surface to receive nameplates.

M. Install nameplate and labels parallel to equipment lines.

N. Secure nameplate to equipment front using screws.

O. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

P. Identify conduit using field painting where required.

Q. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 REFERENCES 1
1.04 DEFINITIONS 2
1.05 ACTION SUBMITTALS 2
1.06 INFORMATIONAL SUBMITTALS 2
1.07 CLOSEOUT SUBMITTALS 2
1.08 QUALITY ASSURANCE 2
1.09 COORDINATION 2
1.10 DELIVERY, STORAGE, AND HANDLING 2
PART 2 PRODUCTS 3
2.01 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS 3
2.02 OCCUPANCY SENSORS 3
PART 3 EXECUTION 5
3.01 OCCUPANCY SENSOR INSTALLATION 5
3.02 WIRING INSTALLATION 5
3.03 IDENTIFICATION 5
3.04 FIELD QUALITY CONTROL 6
3.05 ADJUSTING 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following lighting control devices:

1. Occupancy sensors.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.
3. Division 26 Section "Lighting Control Systems" for programmable lighting systems.

1.03 REFERENCES

A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.

B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.

C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.

D. NFPA 70: National Electrical Code.

E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

F. UL 486B: Wire Connectors for Use with Aluminum Conductors.

G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.

H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.

I. UL 917: Clock Operated Switches.

J. UL 1449: Surge Protective Devices.

K. UL 1598: Luminaires.

L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.04 **DEFINITIONS**

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.

D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.

E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.05 **ACTION SUBMITTALS**

A. Product Data: For each type of product indicated including physical data and electrical performance.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Lighting plan showing location, orientation, and coverage area of each sensor.

2. Interconnection diagrams showing field-installed wiring.

1.06 **INFORMATIONAL SUBMITTALS**

A. Field quality-control test reports.

1.07 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:

1. Description of operation and servicing procedures.

2. List of major components.

3. Recommended spare parts.

4. Programming instructions and system operation procedures.

1.08 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.09 **COORDINATION**

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, fire-suppression system, and partition assemblies.

B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.

1.10 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver products to the site under provisions of Division 26 Section “Electrical General Requirements”.

B. Store and protect products under provisions of Division 26 Section “Electrical General Requirements”.

PART 2 PRODUCTS

2.01 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.02 OCCUPANCY SENSORS

A. General

1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer's recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.
4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.

B. Wall Switch Passive Infrared Occupancy Sensor

1. Manufacturers:
   a. Perfect Sense – PS-PWS
   b. Wattstopper PW-100.
   c. Hubbell Building Automation SOM 101.
   d. Greengate OSW-P-0451-W.
   e. Sensorswitch WSD.
   f. Philips LRS2210.
   g. Leviton ODS10-IDW.
2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
   a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
   b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
   c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes.
   d. Device Body: White, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with "decora" style switch plate.

C. 360° Ceiling Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
   a. Perfect Sense CDS.
   b. Wattstopper DT 300

c. Hubbell Building Automation “OMNI-DT” Series.

d. Greengate OMC-DT-2000-R.

e. Sensorswitch CM-PDT-R.

f. Philips LRM2255.

g. Leviton OSC10-M0W.

2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.

a. Housing: White, thermoplastic, tamper resistant ceiling mount.

b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.

c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.

d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.

e. Manual override function.

D. 360° Ceiling Mounted Ultrasonic Occupancy Sensors

1. Manufacturers:

a. Perfect Sense WDS.

b. Wattstopper “WT” Series.

c. Hubbell Building Automation “OMNI-US” Series.

d. Greengate OPC-U-2000.

e. Sensorswitch CM MPT-10.

f. Philips LRM2255.

g. Leviton OSC20-U0W.

2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.

a. Housing: White, thermoplastic, tamper resistant.

b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.

c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.

d. Manual override function.

E. Occupancy Sensor Control Units:

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.

a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.

b. Occupancy sensor control units shall mount external to 4” sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.

c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.

d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.

e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.

f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

PART 3 EXECUTION

3.01 OCCUPANCY SENSOR INSTALLATION

A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.

B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.

C. Locate sensors such that motion through open doors will not falsely activate sensors.

D. Do not locate ultrasonic sensors within six feet of supply air diffusers.

E. Locate infrared sensors to avoid obstructions.

F. Provide the services of a manufacturer’s representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.

G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.02 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.04 **FIELD QUALITY CONTROL**

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 **ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 0943 - LIGHTING CONTROL SYSTEMS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 ACTION SUBMITTALS 2
1.05 INFORMATIONAL SUBMITTALS 2
1.06 CLOSEOUT SUBMITTALS 2
1.07 QUALITY ASSURANCE 3
1.08 COORDINATION 3
1.09 WARRANTY 3
1.10 EXTRA MATERIALS 3
1.11 SOFTWARE SERVICE AGREEMENT 3
1.12 SYSTEM COMMISSIONING 4
PART 2 PRODUCTS 4
2.01 MANUFACTURERS 4
2.02 SYSTEM PERFORMANCE REQUIREMENTS 4
2.03 SYSTEM SOFTWARE INTERFACES 5
2.04 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT 6
2.05 WIRED NETWORKED DEVICES 7
2.06 CONDUCTORS AND CABLES 9
PART 3 EXECUTION 9
3.01 WIRING INSTALLATION 9
3.02 INSTALLATION REQUIREMENTS 10
3.03 SYSTEM STARTUP 10
3.04 DOCUMENTATION 10
3.05 FIELD QUALITY CONTROL 11
3.06 SYSTEM COMMISSIONING 11
3.07 SOFTWARE INSTALLATION 11
3.08 ADJUSTING 11
3.09 DEMONSTRATION 11
3.10 MANUFACTURER SUPPORT 11

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the design and installation programmable automatic lighting controls with all input and control devices necessary to meet the performance indicated on the contract drawings and this specification.

B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multi-pole contactors.

2. Division 26 Section “LED Interior Lighting” for luminaire specifications and accessories.

1.03 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. Lon Works: A control network technology platform for designing and implementing interoperable control devices and networks.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

D. RS-485: A serial network protocol, like RS-232, complying with TIA/EIA-485-A.

1.04 **ACTION SUBMITTALS**

A. Product Data: Indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature for all sensors, relays, dimming modules, control stations and other devices necessary for complete operation of the system

B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.

1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements for all system components requiring field installation.

2. Riser Diagram: Show interconnection between all system components.

a. Identify complete data communication backbone and interconnection between sensors, relays, dimming modules control stations and other components.

b. Identify typical room/area type configurations.

c. Indicate interconnections with emergency egress lighting relays and transfer devices required.

3. Information Technology (IT) connection: Provide information pertaining to interconnection with facility IT networking equipment and third-party systems.

4. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).

5. Contractor startup and commissioning worksheet.

C. Submit qualifications of commissioning agent and draft functional test plans for review and approval.

1.05 **INFORMATIONAL SUBMITTALS**

A. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

B. Field quality-control test reports and commissioning reports at project closeout.

1.06 **CLOSEOUT SUBMITTALS**

A. Software licenses and upgrades required by and installed for operation and programming of digital devices.

B. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals. Include the following:

1. Software manuals.

2. Operation of adjustable zone controls.

3. Description of operation and servicing procedures.

4. List of major components and recommended parts.

5. System operation and integration instructions.

C. Warranty: Special warranty specified in this Section.

1.07 **QUALITY ASSURANCE**

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer with total responsibility for compatibility of lighting control system components specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70.

E. Listed as qualified under Design Lights Consortium (DLC) Networked Lighting Control System Specification V2.0.

F. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.

G. Comply with ASHRAE 90.1 – 2013.

1.08 **COORDINATION**

A. Coordinate lighting control components specified in this Section and with systems and components specified in other Sections to form an integrated interconnection of compatible components.

B. Match components and interconnections for optimum performance of lighting control functions.

C. Provide open protocol interface for interoperability with building automation system including status of each occupancy/vacancy sensor, control station, dimming module, relay, time schedule, display graphics and status of lighting controls by zone.

D. Coordinate lighting controls with devices specified in Division 26 Section “Lighting Control Devices”.

1.09 **WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.10 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Batteries for all sensors and switches: Quantity equal to 10% percent of each type and size, but no fewer than 3 of each type and size.

1.11 **SOFTWARE SERVICE AGREEMENT**

A. Technical Support: Beginning with Substantial Completion, provide software support for five years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.

1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.12 **SYSTEM COMMISSIONING**

A. Provide the services of a third party, independent agent to perform functional testing and verification of the lighting control system to comply with the requirements of ASHRAE 90.1 – 2013.

B. Perform functional testing of all lighting control system operations.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acuity nLight Air
2. Lutron Vive
3. WaveLinx – Cooper Lighting

2.02 **SYSTEM PERFORMANCE REQUIREMENTS**

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) system backbone for remote, time based and global operation between control zones.
    a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible to minimize overall device count of system.
    b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”
    c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone.
2. The system shall provide individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.
3. Lighting control zones shall be networked with a higher-level system backbone to provide time-based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality later.

5. System shall be capable of “out of box” sequence of operation for each control zone. Standard sequence is:
    a. All switches control all fixtures in a zone.
    b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networked Control Zone Characteristics
1. All networked devices connected with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
    c. Emergency egress devices shall be provided, and UL labeled by the lighting control manufacturer.

C. System Integration Capabilities
1. The system shall be capable of interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.
    a. Systems utilizing a third-party converter or systems that require a dedicated server to achieve integration are not acceptable.

2.03 SYSTEM SOFTWARE INTERFACES

A. Management Interface
1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface
1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud-based server.

C. Visualization Interfaces

1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
    a. Switch, occupancy and photo sensor group configuration
    b. Manual/automatic on modes
    c. Turn-on dim level
    d. Occupancy sensor time delays
    e. Dual technology occupancy sensors sensitivity
    f. Photo-sensor calibration adjustment and auto-setpoint
    g. Trim level settings

2.04 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller

1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
    a. Facilitation of global network communication between different areas and control zones.
    b. Time-based control of downstream wired and wireless network devices.
    c. Linking into an Ethernet network.
    d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
    e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
    a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.

b. BACnet/MSTP shall support 9600 to 115200 baud.

c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.

d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

2.05 **WIRED NETWORKED DEVICES**

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

1. Wall switches & dimmers shall support the following device options:

a. Number of control zones: 1, 2 or 4. Gang multiple switches where more than 4 control zones are required in a single location under a single faceplate.

b. Control Types Supported: On/Off or On/Off/Dimming

2. Scene controllers shall support the following device options:

a. Number of scenes: 1, 2 or 4

b. Control Types Supported:

1) On/Off or On/Off/Dimming

2) Preset Level Scene Type

3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene

4) Selecting a lighting profile to be run by the system’s upstream controller to implement a selected lighting profile across multiple zones

3. Match color specified in Division 26 Section "Wiring Devices."

4. Integral green LED pilot light to indicate when circuit is on.

5. Internal white LED locator light to illuminate when circuit is off.

6. Networked switch stations shall have backlit buttons.

7. Wall Plates:

a. Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."

b. Where multiple switches and/or dimmers are adjacent to each other, install a single cover plate. Provide separate boxes or barriers as required for the application.

c. Provide cover plates that are identical in material and dimension to standard single and double gang switch plates.

d. Verify back box requirements for multiple control points with manufacturer.

8. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

B. Wired Networked Graphic Wall Stations

1. Device shall have a full color touch screen.

2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.

3. Graphic wall stations shall support the following device options:

a. Number of control zones: Minimum of 16

b. Number of scenes: Minimum of 16

c. Optional password protection for setup screens.

C. Wired Networked Auxiliary Input / Output (I/O) Devices

1. Auxiliary Input/output Devices shall be specified as an input or output device with the following options:

a. Contact closure input: Programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.

b. 0-10V analog input: Programmable to function as a daylight sensor.

c. RS-232/RS-485 digital input: Supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.

d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current programmable to support all standard sequence of operations supported by system.

D. Wired Networked Occupancy and Photosensors

1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.

2. Sensing technologies that are acoustically passive, meaning they do not transmit sounds waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.

3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.

4. Sensor mounting type shall match project design requirements as shown on plans.

a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.

5. The system shall support the following types of photocell-based control:

a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.

b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networked Wall Switch Sensors

1. Wall switches sensors shall support the following device options:

a. User Input Control Types Supported: On/Off or On/Off/Dimming

b. Occupancy Sensing Technology: PIR only or Dual Tech

c. Daylight Sensing Option: Inhibit Photosensor

F. Wired Networked Embedded Sensors

1. Embedded sensors shall support the following device options:

a. Occupancy Sensing technology: PIR only or Dual Tech

b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

G. Distributed System Power, Switching and Dimming Controls

1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
3. Device shall be plenum rated.
4. Devices shall be UL Listed for load and load type as specified on the plans.

H. Wired Networked Luminaires

1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
2. Networked LED luminaire shall provide low voltage power to other networked control devices.
3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

2.06 CONDUCTORS AND CABLES

A. General: All conductors and cables shall comply with the requirements of Division 26 Section "Conductors and Cables." Where cable is permitted to be installed exposed in ceiling space, provide plenum rated cable.

B. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG.

C. Classes 2 and 3 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 22 AWG.

D. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.

E. Digital and Multiplexed Signal Cables: As required by system manufacturer. Provide plenum rated cables where installed exposed in ceiling space.

PART 3 EXECUTION

3.01 WIRING INSTALLATION

A. The lighting control system shall be installed and connected as shown on the plans and as directed by the manufacturer.

B. Comply with NECA 1.

C. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Comply with Division 26 Sections "Conductors and Cables" and “Raceways and Boxes”.

D. Where cables are installed in finished areas with exposed construction, conceal cables from view. Route at top of structural systems and conceal on top of structural members where possible. Where cable is exposed to view, provide raceway. As an alternative to raceway, provide cable that is factory colored to match exposed ceiling. Submit sample to Architect for approval.

E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

F. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

G. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

H. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes as per manufacturers' recommendations.

I. Identify components and power and control wiring according to Division26 Section "Electrical Identification."

J. Label each relay with a unique designation.

3.02 **INSTALLATION REQUIREMENTS**

A. Review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.

B. Install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals, plans and specifications.

C. Coordination with Owner's IT Network Infrastructure to secure all required network connections to the owner's IT network infrastructure. Provide the owner's representative with all network infrastructure requirements of the networked lighting control system. Provide the manufacturer's representative with all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.

D. Verify integration and interoperability scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

3.03 **SYSTEM STARTUP**

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.

1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.

B. System start-up and programming shall include:

1. Verifying operational communication to all system devices.

2. Programming the network devices into functional control zones to meet the required sequence of operation.

3. Programming and verifying all sequence of operations.

4. Customization of owner's software interfaces and applications.

C. Initial start-up and programming are to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.04 **DOCUMENTATION**

A. Submit software database file with desired device labels and notes completed.

B. Document the installed location of all networked devices, including networked luminaires. Provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

3.05 **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections and assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.06 **SYSTEM COMMISSIONING**

A. Facilitate the functional testing and verification of the lighting control system by an independent, third party commissioning agent.

B. Perform commissioning in the presence of the Owner’s representative.

C. Submit functional test plan checklist signed by the commissioning agent.

3.07 **SOFTWARE INSTALLATION**

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.08 **ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting programming functions and other system parameters and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.09 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to program, adjust, operate, and maintain lighting controls.

B. Demonstration shall be done only after initial system start-up setup has occurred and system is functioning properly.

C. Demonstration shall consist of a four-hour minimum session.

3.10 **MANUFACTURER SUPPORT**

A. Manufacturer telephone support shall be available at no cost to the Owner during the warranty period and shall include the following:

1. Assistance in solving programming or other application issues pertaining to the control equipment.
2. The manufacturer shall provide a toll-free number for direct technical support available 7 days a week, 24 hours a day.
3. A factory authorized technician shall be located within a 100-mile radius of the project site.

END OF SECTION

SECTION 26 0999 - ELECTRICAL TESTING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SECTION INCLUDES 1
1.03 REFERENCES 1
1.04 QUALIFICATIONS 2
1.05 PERFORMANCE REQUIREMENTS 2
1.06 TEST INSTRUMENT CALIBRATION 3
1.07 TEST REPORTS 4
PART 2 PRODUCTS (NOT APPLICABLE) 4
PART 3 EXECUTION 4
3.01 THERMOGRAPHIC SURVEY 4

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”
2. Division 26 Section “Conductors and Cables.”
3. Division 26 Section “Grounding and Bonding.”
4. Division 26 Section “Enclosed Controllers.”
5. Division 26 Section “Fuses.”

1.02 SECTION INCLUDES

A. Perform all tests and inspections as specified herein. All references made to “testing firm” shall apply to the work of the Contractor.

B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

C. It is the intent of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design Specifications.

D. The test and inspections shall determine suitability for energization.

E. Equipment to be tested and inspected shall be the equipment shown on the one line diagram and schedules as required by part three of each individual Specification Section. In addition, all equipment that is part of an emergency distribution system shall be tested.

1.03 REFERENCES

A. All inspections and tests shall be in accordance with the latest version of the following codes and standards except as provided otherwise herein.

1. National Electrical Manufacturer's Association - NEMA
2. American Society for Testing and Materials - ASTM
3. Institute of Electrical and Electronic Engineers - IEEE
4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2017
5. InterNational Electrical Testing Association - NETA Maintenance Testing Specifications- MTS-2015

6. American National Standards Institute - ANSI C2: National Electrical Safety Code
7. State and Local Codes and Ordinances
8. Insulated Cable Engineers Association - ICEA
9. Association of Edison Illuminating Companies - AEIC
10. Occupational Safety and Health Administration
11. National Fire Protection Association - NFPA
    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 101: Life Safety Code

1.04 **QUALIFICATIONS**

A. The testing firm shall be corporately independent and function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The lead, on site, technical person and at least 50% of the on site crew shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies in Electrical Power Distribution System Testing.

D. The testing firm shall only utilize technicians who are regularly employed by the firm on a full-time basis for testing services.

E. The Contractor shall submit proof of the above qualifications with bid proposal.

F. The terms test agency, test contractor, testing laboratory, test organization, or contractor test company, shall be construed to mean the testing firm.

G. Acceptable Testing Firms:
    1. Potomac Testing; Phone (248) 689-8980.
    2. Utilities Instrumentation Services; Phone (734) 424-1200.
    3. High Voltage Maintenance Corporation; Phone (248) 305-5596.
    4. Powertech Services, Inc.; Phone (810) 720-2280.
    5. Power Plus Engineering, Inc.; Phone (800) 765-3120.
    6. Premier Power Maintenance, Inc.; (517) 230-6629

1.05 **PERFORMANCE REQUIREMENTS**

A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.

B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.

D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.

E. The testing firm shall maintain a written record of all tests and shall assemble and certify a final test report.

F. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:
    a. Occupational Safety and Health Act.
    b. Accident Prevention Manual for Industrial Operations, National Safety Council.
    c. Applicable state and local safety operating procedures.
    d. NETA Safety/Accident Prevention Program.
    e. Owner's safety practices.
    f. National Fire Protection Association - NFPA 70E.
    g. American National Standards for Personnel Protection.
2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
3. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

1.06 **TEST INSTRUMENT CALIBRATION**

A. Test Instrument Calibration

1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
3. Instruments shall be calibrated in accordance with the following frequency schedule:
    a. Field instruments: Analog - 6 months maximum Digital - 12 months maximum
    b. Laboratory instruments: 12 months
    c. Leased specialty equipment: 12 months (Where accuracy is guaranteed by Lessor)
4. Dated calibration labels shall be visible on all test equipment.
5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

B. Field Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
    a. Maintained in good visual and mechanical condition.
    b. Maintained in safe, operating condition.

C. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.

3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.
4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

1.07 **TEST REPORTS**

A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:
1. A list of visual and mechanical inspections required by Division 26 Specification Sections in a checklist or similar format.
2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.
3. Summary and interpretation of test results detailing problems located and recommended corrective measures.
4. Record of infrared scan and photos showing potential problem locations.
5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.

B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **THERMOGRAPHIC SURVEY**

A. Visual and Mechanical Inspection
1. Remove all necessary covers prior to scanning.
2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned
1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.

C. Provide report indicating the following:
1. Problem area (location of "hot spot").
2. Temperature rise between "hot spot" and normal or reference area.
3. Cause of heat rise.
4. Phase unbalance, if present.
5. Areas scanned.

D. Test Parameters
1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

E. Test Results

1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:

   a. Temperature gradients of 37°F to 44.6°F indicate possible deficiency and warrant investigation.

   b. Temperature gradients of 44.6°F to 59°F indicate deficiency; repair as time permits.

   c. Temperature gradients of 61°F and above indicate major deficiency; repair immediately.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 REFERENCES 2
1.05 ACTION SUBMITTALS 2
1.06 INFORMATIONAL SUBMITTALS 2
1.07 QUALITY ASSURANCE 2
1.08 COORDINATION 2
PART 2 PRODUCTS 2
2.01 GENERAL WIRING DEVICE REQUIREMENTS 2
2.02 STANDARD GRADE RECEPTACLES 3
2.03 GFCI RECEPTACLES 3
2.04 CONTROLLED RECEPTACLES 3
2.05 CORD AND PLUG SETS 4
2.06 WALL SWITCHES 4
2.07 WALL PLATES 4
2.08 FLOOR SERVICE FITTINGS 5
PART 3 EXECUTION 5
3.01 INSTALLATION 5
3.02 IDENTIFICATION 6
3.03 CONNECTIONS 6
3.04 FIELD QUALITY CONTROL 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles
2. Ground-fault circuit interrupter receptacles
3. Controlled receptacles.
4. Device wall plates.
5. Floor service fittings

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. PVC: Polyvinyl chloride.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.04 **REFERENCES**

A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.

B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes

D. NEMA WD 1: General Requirements for Wiring Devices.

E. NEMA WD 6: Wiring Device – Dimensional Requirements.

F. UL 20: General-Use Snap Switches.

G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

H. UL 486B: Wire Connectors for Use with Aluminum Conductors.

I. UL 498: Electrical Attachment Plugs and Receptacles.

J. UL 943: Ground Fault Circuit Interrupters.

K. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.05 **ACTION SUBMITTALS**

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.06 **INFORMATIONAL SUBMITTALS**

A. Field quality control test reports

1.07 **QUALITY ASSURANCE**

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.08 **COORDINATION**

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.01 **GENERAL WIRING DEVICE REQUIREMENTS**

A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, and UL498.

B. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

C. Device Color:

1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Optional Standby Power System: Red.
3. Wall Switches: White, unless otherwise indicated.

2.02 **STANDARD GRADE RECEPTACLES**

A. Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hubbell Wire Device-Kellems: 5352
   b. Eaton/Arrow Hart Wiring Devices: 5362
   c. Leviton: 5362
   d. Legrand, Pass & Seymour: 5362

2.03 **GFCI RECEPTACLES**

A. General:

1. Comply with UL 943

B. Duplex GFCI Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
   a. Hubbell Wiring Device-Kellems: GFRST20
   b. Eaton/Arrow Hart Wiring Devices: SGF20
   c. Leviton: GFNT2
   d. Legrand, Pass & Seymour: 2097

C. Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
   a. Hubbell Wiring Device-Kellems: GFWRST20
   b. Eaton/Arrow Hart Wiring Devices WRSGF20
   c. Leviton: GFWR2
   d. Legrand, Pass & Seymour: 2097TRWR

2.04 **CONTROLLED RECEPTACLES**

A. General:

1. Comply with NEC Article 406.3(E). Provide permanent markings of controlled symbol and the word “controlled”.

B. Dual-Controlled Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hubbell Wiring Device-Kellems: BR20C2
   b. Eaton/Arrow Hart Wiring Devices: 5362CD
   c. Bryant: CBRS20C2

d. Leviton: CR020-2P

e. Legrand, Pass & Seymour: 5362CD

2.05 **CORD AND PLUG SETS**

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.06 **WALL SWITCHES**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Wiring Device-Kellems: 1220 Series
2. Eaton/Arrow Hart Wiring Devices: AH1220 Series
3. Leviton: 1220 Series
4. Legrand, Pass & Seymour: PS20AC Series

B. Device body: Plastic handle.

C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.

E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

F. Provide key type where indicated. Furnish four keys to Owner.

G. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.

1. Switch: 20 A, 120/277-V ac.
2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.07 **WALL PLATES**

A. Manufacturers:

1. Provide wall plates and corresponding wiring devices from same manufacturer.

B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces:
   a. 0.035-inch- thick, satin-finished stainless steel
3. Material for Unfinished Spaces:
   a. Galvanized steel
4. Material for Wet Locations: Gasketed Non-Metallic with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
   a. Manufacturers:
      1) Hubbell: MM420

2) Legrand, Pass & Seymour: WIUC10FRED

3) Eaton/Arrow Hart: WIU-1VX

4) Red Dot: CKPS

5) Intermatic: WP5000

5. Material for Damp Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Weatherproof.

a. Manufacturers:

1) Red Dot Model CCGV, ABB Installation Products

2) Eaton/Arrow Hart WLRD1

3) Legrand, Pass & Seymour

4) Intermatic: WP3110MXD

2.08 **FLOOR SERVICE FITTINGS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Wiring Device-Kellems

2. Legrand, Wiremold

3. Steel City

B. Refer to Floor Service Fitting Schedule on Plan.

C. Compartments: Provide barrier separating power from telecommunications cabling. Provide recessed-type floor service fittings with independent compartments and feed through wiring capability.

D. Provide a blank bracket for any unused gangs.

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Install products in accordance with manufacturer’s instructions.

B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.

C. Install devices and assemblies level, plumb, and square with building lines.

D. Arrangement of Devices:

1. Coordinate locations of outlet boxes provided under Division 26 Section “Raceways and Boxes” to obtain mounting heights indicated on Drawings.

2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.

3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.

4. Install horizontally mounted receptacles with grounding pole on the left.

5. Install GFCI receptacles so that the “Push To Test” and “Reset” designations can be read correctly. If printed in both directions, install with ground pole on top.

6. Install switches with OFF position down.

E. Install cover plates on switch, receptacle, and blank outlets in finished areas.

F. Install weather-resistant type receptacles in all damp and wet locations, including pool environments.

G. Install weatherproof cover plates on receptacles in damp locations.

H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.

I. Use oversized plates for outlets installed in masonry walls.

J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

K. Remove wall plates and protect devices and assemblies during painting.

L. Install properly oriented access floor boxes into cutouts in access floor tiles and secure to tiles per Manufacturer’s instructions.

M. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

N. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section “Electrical Identification” with black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

2. Wall Switches: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section “Electrical Identification” with black-filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.

B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Inspect each wiring device for defects.

2. Operate each wall switch with circuit energized and verify proper operation.

3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.

4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 26 2813 - FUSES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 ACTION SUBMITTALS 1
1.04 QUALITY ASSURANCE 1
1.05 PROJECT CONDITIONS 1
1.06 COORDINATION 1
1.07 EXTRA MATERIALS 2
PART 2 PRODUCTS 2
2.01 MANUFACTURERS 2
2.02 CARTRIDGE FUSES 2
PART 3 EXECUTION 2
3.01 EXAMINATION 2
3.02 INSTALLATION 2
3.03 IDENTIFICATION 2

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in controllers.

1.03 ACTION SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with:

1. NEMA FU 1 – Low Voltage Cartridge Fuses.
2. NFPA 70 – National Electrical Code.
3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
4. UL 198E – Class R Fuses.
5. UL 512 – Fuseholders.

1.05 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.07 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than of each type and size.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 **CARTRIDGE FUSES**

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

1. Motor Branch Circuits: Class RK5, time delay.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.03 **IDENTIFICATION**

A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 REFERENCES 2
1.05 ACTION SUBMITTALS 2
1.06 INFORMATIONAL SUBMITTALS 2
1.07 CLOSEOUT SUBMITTALS 3
PART 2 PRODUCTS 3
2.01 GENERAL REQUIREMENTS 3
2.02 FUSIBLE SWITCHES 3
2.03 NONFUSIBLE SWITCHES 3
2.04 MOLDED-CASE CIRCUIT BREAKERS 4
2.05 ENCLOSURES 4
2.06 TOGGLE DISCONNECT SWITCH 5
PART 3 EXECUTION 5
3.01 EXAMINATION 5
3.02 SELECTION OF ENCLOSURES 5
3.03 INSTALLATION 5
3.04 IDENTIFICATION 6
3.05 FIELD QUALITY CONTROL 6
3.06 ADJUSTING 7
3.07 PROTECTION 7
3.08 CLEANING 7

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Fuses”.
2. Division 26 Section “Hangers and Supports for Electrical Systems”.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Non-fusible switches.
3. Enclosures.

1.03 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault circuit-interrupter for equipment protection.

D. GFLS: Ground-fault circuit-interrupter for life safety.

E. HD: Heavy duty.

F. RMS: Root mean square.

G. SPDT: Single pole, double throw.

1.04 **REFERENCES**

A. NECA 1: Practices for Good Workmanship in Electrical Contracting.

B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.

E. NEMA FU 1: Low Voltage Cartridge Fuses.

F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.

I. NFPA 70: National Electrical Code.

J. UL 50: Enclosures for Electrical Equipment, Non-Environmental Considerations.

K. UL 50E: Enclosures for Electrical Equipment, Environmental Considerations

L. UL 98: Enclosed and Dead-Front Switches

M. UL 489: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

N. UL 1053: Standard For Ground-Fault Sensing and Relaying Equipment.

O. UL 1077: Supplementary Protectors for Use in Electrical Equipment

P. UL 508: Industrial Control Equipment

1.05 **ACTION SUBMITTALS**

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

2. Enclosure types and details for types other than UL 50E, Type 1.

3. Current and voltage ratings.

4. Short-circuit current rating.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.

2. Include wiring diagrams for power, signal, and control wiring.

1.06 **INFORMATIONAL SUBMITTALS**

A. Field quality-control test reports including the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.07 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current curves, including selectable ranges for each type of circuit breaker.

PART 2 PRODUCTS

2.01 **GENERAL REQUIREMENTS**

A. Source Limitations: Obtain products from single manufacturer.

B. 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.

2.02 **FUSIBLE SWITCHES**

A. Manufacturers:

1. Eaton.

2. ABB.

3. Siemens Industries, Inc.

4. Square D by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 **NONFUSIBLE SWITCHES**

A. Manufacturers:

1. Eaton.

2. ABB.

3. Siemens Industries, Inc.

4. Square D by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.04 **MOLDED-CASE CIRCUIT BREAKERS**

A. Manufacturers:

1. Eaton.
2. ABB.
3. Siemens Industries, Inc.
4. Square D by Schneider Electric.

B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

C. 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.

D. 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.

E. MCCBs must be equipped with device for locking in isolated position.

F. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.

G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits.

1. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).

J. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
5. 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.

2.05 **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.

B. Enclosure Finish:

1. Gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1)

2. Gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (UL 50E Types 3R, 12)

C. Operating Mechanism:

1. Directly operable through front cover of enclosure (UL 50E Type 1).
2. Directly operable through dead front trim of enclosure (UL 50E Type 3R).
3. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

2.06 **TOGGLE DISCONNECT SWITCH**

A. Manufacturers:

1. Double Pole:
   a. Hubbell 1372.
   b. Leviton 3032-2W.
   c. Pass & Seymour 7812.
   d. Bryant 30102.
2. Three Pole:
   a. Hubbell 1379.
   b. Leviton MS303-DSW.
   c. Pass & Seymour 7813.
   d. Bryant 30103.

B. Description: Heavy duty, 30A, 600 volts, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **SELECTION OF ENCLOSURES**

A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

B. Outdoor Locations: UL 50E, Type 3R.

C. Other Wet or Damp, Indoor Locations: UL 50E, Type 3R.

3.03 **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.

C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

D. Install switches with off position down.

E. Install NEMA KS 1 enclosed switch for motor loads ½ HP and larger and equipment loads greater than 30A.

F. Install toggle disconnect switch, surface mounted, for motor loads less than ½ HP and equipment loads 30A. and less.

G. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

H. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.

I. Support enclosures independent of connecting conduit or raceway system.

J. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 **IDENTIFICATION**

A. Comply with requirements in Division 26 Section "Electrical Identification."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.
3. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.05 **FIELD QUALITY CONTROL**

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify rating of installed fuses.

B. Perform field quality control tests in accordance with Division 26 section “Electrical Testing”:

C. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:
   a. Inspect physical and mechanical condition.
   b. Verify that unit is clean.
   c. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
   d. Verify that fuse sizes and types match the Specifications and Drawings.
   e. Verify that each fuse has adequate mechanical support and contact integrity.
   f. Verify correct phase barrier installation.
   g. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

D. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

3.07 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.

3.08 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 1
1.05 CLOSEOUT SUBMITTALS 2
1.06 REFERENCES 2
1.07 QUALITY ASSURANCE 2
1.08 DELIVERY, STORAGE, AND HANDLING 2
1.09 PROJECT RECORD DOCUMENTS 3
1.10 PROJECT CONDITIONS 3
1.11 COORDINATION 3
1.12 EXTRA MATERIALS 3
PART 2 PRODUCTS 3
2.01 MANUFACTURERS 3
2.02 ACROSS-THE-LINE ENCLOSED CONTROLLERS 4
2.03 ENCLOSURES 4
2.04 ACCESSORIES 4
2.05 FACTORY FINISHES 4
PART 3 EXECUTION 4
3.01 EXAMINATION 4
3.02 APPLICATIONS 4
3.03 INSTALLATION 5
3.04 IDENTIFICATION 5
3.05 CONTROL WIRING INSTALLATION 5
3.06 CONNECTIONS 5
3.07 FIELD QUALITY CONTROL 5
3.08 ADJUSTING 6
3.09 DEMONSTRATION 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.

B. Related Sections include the following:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    a. Each installed unit's type and details.
    b. Nameplate legends.
    c. Short-circuit current rating of integrated unit.
    d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
2. Wiring Diagrams: Power, signal, and control wiring.

B. Field quality-control test reports.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.

B. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.06 **REFERENCES**

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.

C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).

E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.

F. NECA 402-2000 – Recommended Practice for Installing and Maintaining Motor Control Centers.

G. NEMA AB 1 - Molded Case Circuit Breakers.

H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

I. NEMA KS 1 - Enclosed Switches.

J. ANSI/NFPA 70 - National Electrical Code.

1.07 **QUALITY ASSURANCE**

A. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.08 **DELIVERY, STORAGE, AND HANDLING**

A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.

B. Deliver products to site under provisions of Section 26 0010. Store and protect products under provisions of Section 26 0010.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

E. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.09 **PROJECT RECORD DOCUMENTS**

A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0010.

1.10 **PROJECT 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 according to requirements indicated:

1. Notify Owner’s representative no fewer than seven days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical service without written permission from Owner’s representative.

1.11 **COORDINATION**

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.12 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.
3. Keys: Furnish 2 of each to Owner.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB.
2. Danfoss Inc.; Danfoss Electronic Drives Div.

3. Eaton.
4. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
5. Siemens
6. Square D by Schneider Electric

2.02 **ACROSS-THE-LINE ENCLOSED CONTROLLERS**

A. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
2. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, non-fusible switch.
3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.03 **ENCLOSURES**

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.04 **ACCESSORIES**

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Indicating Lights: Run (Red), off or ready (Green).

C. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.

D. Selector Switch: NEMA ISC 2, mounted in front cover to read “hand/off/auto,” provide auxiliary contact for auto position monitoring.

E. Manufacturer provided nameplate shall be provided on controller enclosure. Nameplate shall contain the following information:

1. Manufacturer’s name or identification.
2. Voltage rating.
3. Current and/or horsepower rating.
4. Short-circuit current rating,

2.05 **FACTORY FINISHES**

A. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **APPLICATIONS**

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.03 **INSTALLATION**

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Install freestanding equipment on concrete bases.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

E. Install motor control equipment and contactors in accordance with manufacturer’s instructions.

F. Select and install heater elements in motor starters to match installed motor characteristics.

G. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.04 **IDENTIFICATION**

A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.05 **CONTROL WIRING INSTALLATION**

A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.06 **CONNECTIONS**

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.07 **FIELD QUALITY CONTROL**

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters." Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.08 **ADJUSTING**

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.09 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Closeout Procedures"

END OF SECTION

SECTION 26 5119 - LED INTERIOR LIGHTING

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 ACTION SUBMITTALS 2
1.05 CLOSEOUT SUBMITTALS 2
1.06 MAINTENANCE MATERIAL SUBMITTALS 2
1.07 QUALITY ASSURANCE 2
1.08 DELIVERY, STORAGE, AND HANDLING 3
1.09 COORDINATION 3
1.10 WARRANTY 3
PART 2 PRODUCTS 3
2.01 LUMINAIRES (LIGHTING FIXTURES) 3
2.02 LUMINAIRE REQUIREMENTS 3
2.03 EXIT SIGNS 4
2.04 EMERGENCY AUTOMATIC LOAD CONTROL RELAY 4
2.05 MATERIALS 5
2.06 METAL FINISHES 5
2.07 LUMINAIRE FIXTURE SUPPORT COMPONENTS 6
PART 3 EXECUTION 6
3.01 EXAMINATION 6
3.02 TEMPORARY LIGHTING 6
3.03 INSTALLATION 6
3.04 CONNECTIONS 7
3.05 IDENTIFICATION 7
3.06 FIELD QUALITY CONTROL 7
3.07 STARTUP SERVICE 8
3.08 ADJUSTING 8
3.09 CLEANING 8

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Division 26 "Lighting Control Devices."
2. Division 26 “Lighting Control Systems”

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lamp: LED and substrate as a replaceable assembly.

F. LED: Light-emitting diode.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 **ACTION SUBMITTALS**

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.

4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.06 **MAINTENANCE MATERIAL SUBMITTALS**

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.

2. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.

1.07 **QUALITY ASSURANCE**

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with:

1. NFPA 70 - National Electrical Code.
2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
4. Code of Federal Regulations (47 CFR 37342).
5. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.

F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.08 **DELIVERY, STORAGE, AND HANDLING**

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.09 **COORDINATION**

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 **WARRANTY**

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) or manufacturer’s standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 **LUMINAIRES (LIGHTING FIXTURES)**

A. Provide Luminaires as included in Luminaire schedule shown on the drawings.

B. Acceptable alternate manufacturers are indicated on the luminaire schedule. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.

2.02 **LUMINAIRE REQUIREMENTS**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

D. Unless otherwise specified in Luminaire product data, provide products with a CCT of 4000 K.

E. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 70,000 hours.

F. Driver

1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.
2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.03 **EXIT SIGNS**

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Provide edge lit signs with a mirror plaque background.

2.04 **EMERGENCY AUTOMATIC LOAD CONTROL RELAY**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bodine BLCD Series.
2. Nine-24, Inc.: ELCR Series.
3. LVS, EPC Series
4. IOTA, ETS-20 Series
5. Functional Devices, Inc., ESR Series
6. ETC, ALCR Series
7. Wattstopper, ELCU series

B. Description:

1. The Automatic Load Control Relay (ALCR) shall provide required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area of the building.
2. The ALCR shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device.
3. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
4. Self-contained with integral ½" nipple mount with snap in locking feature for mounting into a standard junction box knock out.
5. Normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.
6. Universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
7. Integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
8. Dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.

9. Separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
10. Normal power input leads shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
11. Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
12. Utilize zero crossing circuitry to protect relay contacts from inrush current.
13. Plenum rated housing equipped with compression flying leads.
14. The unit shall be UL listed to the UL924 standard and labeled for connection to both normal and emergency lighting power sources.

C. Provide device with proper rating for total load and load type being transferred

D. Provide for devices suitable for line voltage and low voltage dimming control where required such that device bypasses dimming control signal to luminaire to provide full output upon loss of normal power.

E. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings for dimming characteristics.

2.05 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
    a. "USE ONLY" and include specific lamp type.
    b. Lamp diameter, shape, size, wattage, and coating.
    c. CCT and CRI for all luminaires.

2.06 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.07 **LUMINAIRE FIXTURE SUPPORT COMPONENTS**

A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **TEMPORARY LIGHTING**

A. Do not use permanent luminaires for temporary lighting.

3.03 **INSTALLATION**

A. Install in accordance with manufacturer’s instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.

B. Locate ceiling luminaires as indicated on reflected ceiling plan.

C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.

2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

D. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.

E. Install recessed luminaires to permit removal from below.

F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

G. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

H. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.

I. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

J. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

K. Ceiling-Mounted Luminaire Support:
1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length

L. Suspended Luminaire Support:
1. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
2. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

M. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.

N. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.

O. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

3.04 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 and UL 486B.

B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

C. Bond products and metal accessories to branch circuit equipment grounding conductor.

D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.07 **STARTUP SERVICE**

A. Comply with requirements for startup specified in Division 26 Section "Lighting Control Systems."

3.08 **ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Adjust exit sign directional arrows as indicated on Drawings.

C. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner’s representative and Architect/Engineer.

3.09 **CLEANING**

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosures and lenses.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION

SECTION 28 3100 - FIRE ALARM

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 SYSTEM DESCRIPTION 2
1.05 PERFORMANCE REQUIREMENTS 2
1.06 ACTION SUBMITTALS 2
1.07 INFORMATIONAL SUBMITTALS 3
1.08 CLOSEOUT SUBMITTALS 4
1.09 MAINTENANCE MATERIAL SUBMITTALS 4
1.10 QUALITY ASSURANCE 5
1.11 PROJECT CONDITIONS 5
1.12 SEQUENCING AND SCHEDULING 5
1.13 EXTRA MATERIALS 5
PART 2 PRODUCTS 5
2.01 MANUFACTURERS 5
2.02 EXISTING FIRE ALARM SYSTEM 6
2.03 MANUAL FIRE ALARM BOXES 6
2.04 SYSTEM SMOKE DETECTORS 6
2.05 NOTIFICATION APPLIANCES 7
2.06 REMOTE STATUS AND ALARM INDICATORS 7
2.07 ADDRESSABLE MONITORING MODULE 7
2.08 ADDRESSABLE CONTROL MODULE 8
2.09 WIRE AND CABLE 8
PART 3 EXECUTION 8
3.01 EQUIPMENT INSTALLATION 8
3.02 WIRING INSTALLATION 9
3.03 IDENTIFICATION 10
3.04 GROUNDING 10
3.05 FIELD QUALITY CONTROL 10
3.06 PROGRAMMING 10
3.07 ADJUSTING 11
3.08 WARRANTY 11
3.09 DEMONSTRATION 11

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”

1.02 SUMMARY

A. This Section includes design and installation of new devices onto an existing fire alarm system.

1.03 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 **SYSTEM DESCRIPTION**

A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

B. Fire alarm system shall consist of the following:

1. System smoke detection above all control panels and notification appliance power supply panels.
2. System smoke detection as required at air handling units, smoke rated transfer openings, and smoke damper locations.
3. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
4. Audible and visual notification appliances in all public and common areas of the building.
5. Emergency Generator Monitoring

1.05 **PERFORMANCE REQUIREMENTS**

A. Comply with NFPA 72.

B. Comply with NFPA 70.

C. Comply with NFPA 720.

D. A complete functional system meeting the requirements of this specification, including alarm initiating devices and notification appliances at locations and ratings to meet the requirements of the Authorities Having Jurisdiction and all applicable codes shall be provided.

E. Coordinate and avoid conflicts with casework, markerboards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.

F. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.

G. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.

H. Obtain and refer to mechanical drawings for smoke damper locations, smoke rated transfer openings, and air handling equipment CFM’s. Provide smoke detection as required by applicable codes.

I. Coordinate with fire protection contractor and approved shop drawings for all control and monitoring requirements of the fire protection system.

J. Premises protection includes Group B Type building use group.

1. Refer to drawings for complete code analysis including construction type, use groups, special occupancy types, rated walls, smoke barriers and partitions, etc.

K. System functional performance shall be as indicated on the fire alarm matrix on the drawings.

1.06 **ACTION SUBMITTALS**

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, and details, including details of attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
    c. Locate detectors in accordance with manufacturer's written instructions.
    d. Show air-sampling detector pipe routing.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.07 **INFORMATIONAL SUBMITTALS**

A. Qualification Statements: For Installer.

B. Field quality-control test reports.

C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

1.08 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.

c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.

d. Riser diagram.

e. Device addresses.

f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.

g. Record copy of site-specific software.

h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.

2) Frequency of testing of installed components.

3) Frequency of inspection of installed components.

4) Requirements and recommendations related to results of maintenance.

5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.

j. Abbreviated operating instructions for mounting at FACP and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On approved online or cloud solution.

3. Device address list.

4. Printout of software application and graphic screens.

1.09 **MAINTENANCE MATERIAL SUBMITTALS**

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

3. Smoke Detectors and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.

4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.10 **QUALITY ASSURANCE**

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.11 **PROJECT CONDITIONS**

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify the Owner’s representative no fewer than seven days in advance of proposed interruption of fire alarm service.
2. Do not proceed with interruption of fire alarm service without written permission from the Owner’s representative.

1.12 **SEQUENCING AND SCHEDULING**

A. Existing Fire Alarm Equipment: Maintain fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of the new fire alarm system, remove existing disconnected fire alarm equipment.

1.13 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
2. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
4. Keys and Tools: One extra set for access to locked and tamperproofed components.
5. Audible and Visual Notification Appliances: One of each type installed.
6. Fuses: Two of each type installed in the system.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:
    a. National Time & Signal.

2.02 **EXISTING FIRE ALARM SYSTEM**

A. Compatibility with Existing Equipment: Fire alarm system and components shall operate as an extension of an existing system.

2.03 **MANUAL FIRE ALARM BOXES**

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
2. Station Reset: Key- or wrench-operated switch.

2.04 **SYSTEM SMOKE DETECTORS**

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:
    a. Sensor: LED or infrared light source with matching silicon-cell receiver.
    b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.

7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

8. Each sensor shall have multiple levels of detection sensitivity.

9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.

10. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.

2.05 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

2. Finishes:

a. Wall mounted appliances: Provide red finish with white lettering.

b. Ceiling Mounted Appliances: Provide white finish.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under 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: 15, 30, 60, 75, 110, 135, 185 candela as required to meet NFPA 72 requirements.

2. Strobe Leads: Factory connected to screw terminals.

2.06 REMOTE STATUS AND ALARM INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.07 ADDRESSABLE MONITORING MODULE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

2.08 ADDRESSABLE CONTROL MODULE

A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:

1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

2.09 **WIRE AND CABLE**

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.

C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):

1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
3. PLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Circuit integrity cable, NFPA 70 Article 760, Classification CI, UL listed as Type FPL, FPLR or FPLP as required, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

D. Non-Power-Limited Fire Alarm Circuits (NPLFA):

1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   a. Low-Voltage Circuits: No. 16 AWG, minimum.
   b. Line-Voltage Circuits: No. 12 AWG, minimum.
2. NPLFA circuit cable installed exposed in ceiling spaces, risers and elsewhere: Multi-conductor cable, U.L Listed type NPLFP.
3. NPLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Multi-conductor cable, U.L Listed type NPLFP-CI
4. NPLFA circuit cable installed exposed in ceiling spaces, shafts and elsewhere: Multi-conductor Armored Cable, NFPA 70 Type MC, copper conductors, copper drain wire, aluminum or steel armor with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 EXECUTION

3.01 **EQUIPMENT INSTALLATION**

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to the existing control panel in the existing part of the building.
2. Connect new equipment to the existing monitoring equipment at the Supervising Station.
3. Expand, modify, and supplement the existing control and monitoring equipment as necessary to extend the existing control and monitoring functions to the new points.
4. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

B. Smoke Detector Spacing:

1. Smooth ceiling spacing shall not exceed 30 feet, or the listed spacing of the detectors, whichever is less.

C. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

D. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.

E. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector that is above 10'-0" aff, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.

F. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.

G. Visible Alarm Notification Appliances: Install wall mounted appliances at 96" AFF or 6 inches below the ceiling, whichever is less.

H. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.

I. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.

J. Install notification appliances on existing CMU walls on surface back-boxes matching the dimensions and finish of the notification appliance.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Provide all 120V branch circuits for all control panels, sub panels, and ancillary equipment required for the system.

3.02 **WIRING INSTALLATION**

A. Install wiring according to the following:

1. NECA 1.

2. TIA/EIA 568-A.

B. Wiring Method:

1. Fire alarm circuits shall consist of multi-conductor cables installed in accessible ceiling spaces.

2. Where ceilings consist of exposed construction, fire alarm multi-conductor cable shall be installed on top of joists, beams etc. and shall be concealed from view. Where the structural elements do not allow for the cable to be installed in a concealed fashion, then install the cable in conduit.

3. Install fire alarm cable in conduit in mechanical rooms, loading docks and similar service spaces.

4. Drops to surface mounted devices shall be installed in conduit or surface raceway. No exposed cable shall be visible below the ceiling. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.

5. Drops to devices recessed in partition walls shall be installed in conduit.

6. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.

7. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits, if the system manufacturer permits it.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with

the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.03 **IDENTIFICATION**

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section “Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.04 **GROUNDING**

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.05 **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.

   a. Include the existing system in tests and inspections.

2. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.

3. Testing: Follow procedure and record results complying with requirements in NFPA 72.

   a. Detectors that are outside their marked sensitivity range shall be replaced.

4. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.06 **PROGRAMMING**

A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.07 **ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

3.08 **WARRANTY**

A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

3.09 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION