

cPort Credit Union

50 India Street

Portland, Maine

Date: August 4, 2017

Prepared for:

cPort Credit Union
50 India Street
Portland, Maine

Owner:

cPort Credit Union
50 Riverside Industrial Parkway
Portland, Maine 04103

PRICING PHASE

SPECIFICATION

GTA # 010416

**GAWRON
TURGEON**
ARCHITECTS

ARCHITECTURE
INTERIOR DESIGN
LANDSCAPE ARCHITECTURE
MASTER PLANNING

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

00002

SIGNATURES

OWNER: _____ DATE: _____
cPort Credit Union
50 Riverside Industrial Parkway
Portland, Maine 04103

ARCHITECT: _____ DATE: _____
Gawron Turgeon Architects
29 Black Point Road
Scarborough, Maine 04074

CONTRACTOR: _____ DATE: _____
Landry French Construction Company
160 Pleasant Hill Road
Scarborough, Maine 04074

00003

TABLE OF CONTENTS

CPORT CREDIT UNION

50 India Street
Portland, Maine

00001	Cover Page
00002	Signatures
00003	Table of Contents
00004	List of Drawings
00005	Geotechnical Report
00007	Bank Equipment
	- Teller Receiving Safe / Night Deposit
	- Deal Drawer Unit
	- Currency Recycler
	- ATM
	- Security & Fire Alarm System

BIDDING REQUIREMENTS

Prepared by Landry French Construction Company

CONTRACT FORMS

Prepared by Landry French Construction Company

CONDITION OF CONTRACT

Prepared by Landry French Construction Company

DIVISION 1 - GENERAL REQUIREMENTS

001100	- Summary
012100	- Allowances
012200	- Unit Prices
012300	- Alternates
012600	- Contract Modification Procedures
012900	- Payment Procedures
013100	- Project Management and Coordination
013300	- Submittal Procedure
014000	- Quality Requirements
014200	- References
015000	- Temporary Facilities and Controls
015719	- Indoor Air Quality Management

016000 - Product Requirements
016300 - Substitutions and Product Options
017300 - Execution Requirements
017329 - Cutting and Patching
017419 - Construction Waste Management
017700 - Closeout Procedures
017823 - Operation and Maintenance Data
017839 - Project Record Documents
017900 - Demonstration and Training

DIVISION 2 – EXISTING CONDITIONS

024119 - Selective Demolition and Alterations

DIVISION 3 - CONCRETE

033000 - Cast-In-Place Concrete - From Allied Engineering

DIVISION 4 - MASONRY

042000 - Brick, Concrete Masonry Units
044313 - Stone Masonry Veneer

DIVISION 5 - METALS

051200 - Structural Steel - From Allied Engineering
053100 - Steel Deck – From Allied Engineering
055000 - Metal Fabrications
055100 – Metal Stairs
057310 – Taper-Loc Dry Glaze Glass Railing System

DIVISION 6 - CARPENTRY

061100 - Rough Carpentry
064000 - Interior Architectural Woodwork

DIVISION 7 - MOISTURE PROTECTION

070120 - Building Envelope Air Sealing
071000 - Cementitious Waterproofing
071113 - Bituminous Damp Proofing
072100 - Building Insulation
072110 - Spray-In-Place Rigid Urethane Foam Insulation

072630 – Vapor Permeable Air Barrier System
074213 – Metal Composite Wall Panels (ACM)
074243 - Composite Wall Panels
075423 - Thermoplastic Membrane Roofing
076200 - Sheet Metal Flashing and Trim
077200 - Roof Accessories
077616 – Porcelain Roof Pavers
078410 - Through-Penetration Firestop Systems
079200 - Joint Sealants

DIVISION 8 - DOORS AND WINDOWS

081100 - Steel Doors and Frames
083100 - Access Doors and Frame
084110 - Aluminum Storefront
087100 - Finish Hardware, Access Control, Low Voltage Wiring
088000 - Glazing
089110 - Glazed Aluminum Curtain Walls

DIVISION 9 - FINISHES

092300 - Gypsum Board Assemblies
093100 - Tile
095110 - Acoustical Panel Ceilings
096800 - Carpet
099000 - Painting

DIVISION 10 - SPECIALTIES

104310 - Signage
105200 - Fire-Protection Specialties
108010 - Toilet and Bath Accessories
108500 - Building Specialties

DIVISION 11 - EQUIPMENT

110450 - Residential Appliances

DIVISION 12 - FURNISHINGS

124813 - Floor Mats and Frames
124940 – Bead Chain Clutch Operated Flexshades
129300 – Site Furnishings

DIVISION 13 - SPECIAL CONSTRUCTION

NOT USED

DIVISION 14 - CONVEYING SYSTEMS

142400 – Hydraulic Elevators

DIVISION 21 - FIRE SUPPRESSION

211000 – Fire-Suppression Sprinklers

DIVISION 22 - PLUMBING

220500 – Common Work Results for Plumbing
220519 – Thermometers and Pressure Gauges for Plumbing
220529 – Hangers and Supports for Plumbing Piping and Equipment
220553 – Identification for Plumbing Piping & Equipment
220700 – Plumbing Insulation
221116 – Domestic Water Piping
221119 – Plumbing Specialties
221316 - Plumbing Sanitary and Storm Piping
221429 – Sump Pumps
223400 – Fuel-Fired, Domestic Water Heaters
224000 – Plumbing Fixtures

DIVISION 23 - MECHANICAL

230500 – Common Work Results for Mechanical
230519 – Thermometers and Pressure Gauges
230529 – Hangers and Supports for Piping and Equipment
230553 - Identification for Mechanical
230593 – Testing, Adjusting and Balancing for HVAC
230700 – Mechanical Insulation
230900 – Instrumentation and Control for HVAC
230993 – Sequence of Operations
231123 – Facility Fuel Gas Piping
232113 – Hydronic HVAC Piping
232123 – Hydronic Pumps
232300 – Refrigerant Piping
233113 – Ductwork
233713 – Diffusers, Registers and Grilles
237200 – Air-to-Air Energy Recovery Equipment
238130 – Ductless Split System Air Conditioning Units
238216 – Duct Mounted Hot Water Heating Coils
238239 – Cabinet Unit Heaters
238239.16 – Propeller Unit Heaters
238316 – Radiant Heating Hydronic Piping

DIVISION 26 – ELECTRICAL

Sections Prepared by Allied Engineering

DIVISION 27 - COMMUNICATIONS

271500 - Communications Horizontal Cabling – By Others

DIVISION 31 – EARTHWORK

312000 - Earth Moving

316216 – Steel Piles

DIVISION 32 – EXTERIOR IMPROVEMENTS

320000 – Selective Site Demolition

321216 – Asphalt Paving

321613.43 – Granite Curbing

321723 – Pavement Markings

321726 – Tactile Warning Surfacing

321729 – Traffic Signs

DIVISION 33 – UTILITIES

330516 – Utility Structures

331100 – Water Utility Distribution Piping

333100 – Sanitary Utility Sewerage Piping

334100 – Storm Utility Drainage Piping

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

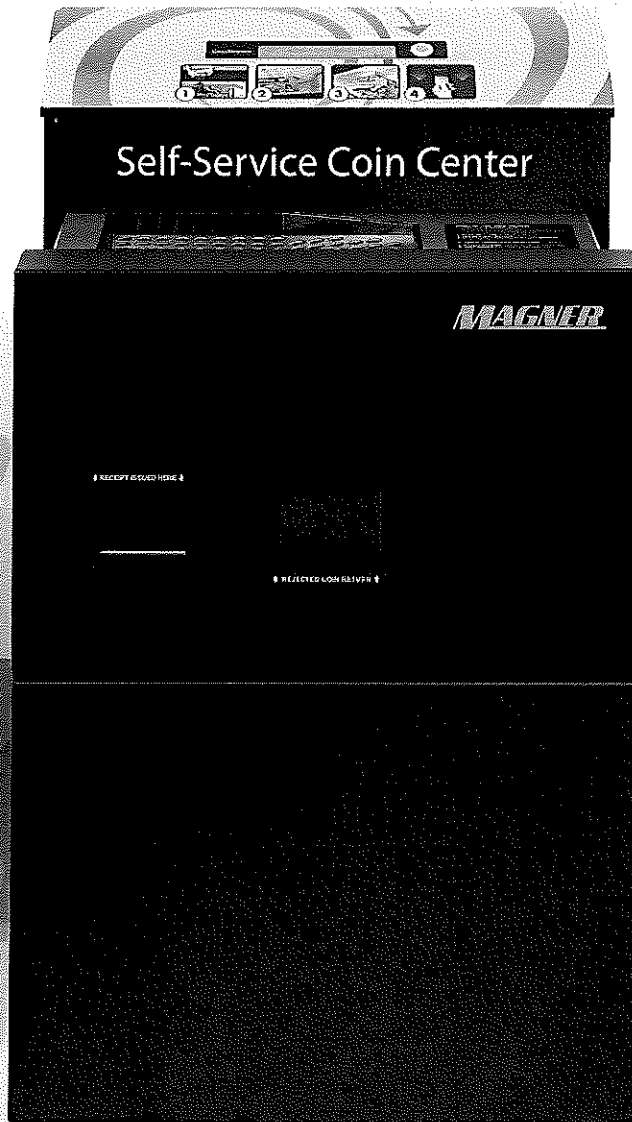
LIST OF DRAWINGS

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

00005

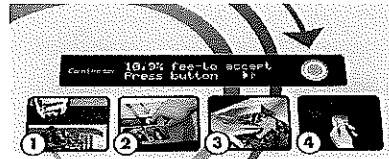
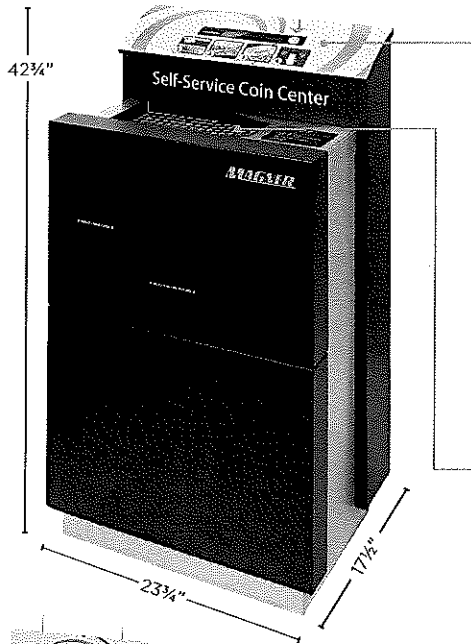
GEOTECHNICAL REPORT

400 SERIES

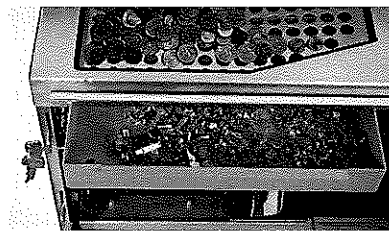


400 SERIES

SELF-SERVICE COIN
MADE SIMPLE *and* AFFORDABLE



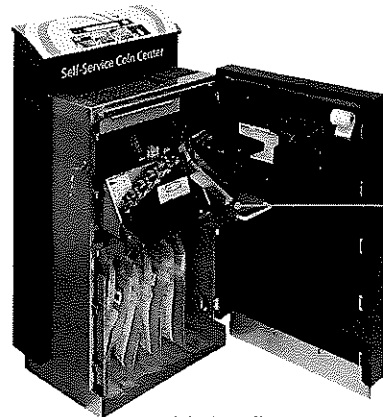
Simple One Button Operation
Easy to read, prompting display and instructional photos.



Large Inspection Tray
Designed to remove a majority of dirt and foreign matter to the trash drawer.



Optional sign



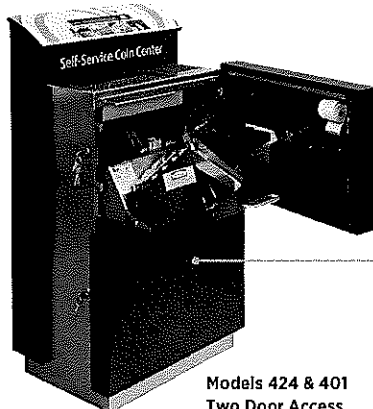
Model 405 Full Sort to 5 Bags
Single Door Access

Pull-out Shelf
For easy access to the entire counting and sorting mechanism.

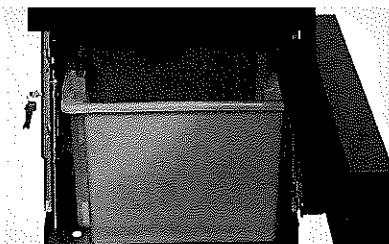
Easy Access to Bags, Tub or Vault



Model 424 Mixed Out to 4 Bags



Models 424 & 401
Two Door Access



Model 401 Mixed Out to Tub or Vault

SPECIFICATIONS

Coins Counted

U.S. - 1¢, 5¢, 10¢, 25¢, 50¢ and \$1
Canada - 1¢, 5¢, 10¢, 25¢, \$1 and \$2

Counting Speed Up to 850 coins per minute

Coin Input Manual feed from inspection tray

Alloy Count Sensor Technology

Accurately counts all six U.S. denominations
Rejects foreign coins and slugs back to user

Display Two line LCD

Status Indicator Light

Error Status Messaging

Fees Two, programmable

Languages

English; English & Spanish

CHOICE OF OUTPUT

Model 405 Full sort with exact bag stops for 5 bags: 1¢, 5¢, 10¢, 25¢, 50¢/\$1; programmable for Federal Reserve half or full bags

Model 424 Mixed coin output to 4 bags, programmable by weight or piece count

Model 401 Mixed coin output to a tub or vault (approximately 52,000 coin capacity), programmable by weight or piece count

Accuracy 99.995%

Approximate Dimensions

23 3/4" W x 17 1/2" D x 42 3/4" H
(69 1/4" H with optional sign)

Net Weight 145 lbs

Power Source

External 24v power supply
low voltage, standard 110V outlet

Operating Temperature Limits

+41° to 104° F (0° to +40° C)

Options "More Choices"

- CoinStream sign for wall mounting or ceiling hanging
- Promotional pieces: Door & wall decals, floor decals, buttons, tent cards
- Custom colors & wraps
- Digital marketing
- Host communications software

Specifications are approximate and subject to change

MAGNER®

Magner Corporation of America
41 West Street
Middlefield, Connecticut USA 06455

Phone: 860-349-1097
800-243-2624

Email: CDS@magner.com
www.selfservicecoin.com

Form CDS 400 Series

THE WORLD LEADER IN CASH RECYCLING TECHNOLOGY
WITH OVER 110,000 UNITS INSTALLED, MORE THAN ALL
OTHERS COMBINED

To meet the challenges and gain the competitive edge in today's tough business environment successful financial institutions require efficient and proven solutions. That means choosing a business partner that provides the latest technology innovations, industry expertise and award winning customer service.

GLORY's RBG-100, an iCR™ Intelligent Cash Recycler, answers these challenges by providing an efficient high performance cash management solution designed to be installed in teller lines to process customer transactions, ATM pulls, large deposits and teller vault buys and sells.

ADVANTAGE GLORY

iCR™ Intelligent Cash Recycler

Up to 17,100 Note Capacity

Can accommodate up to 12,600 recyclable note capacity and a secure overflow drawer of 4,500 notes.

Advanced Error Recovery

By incorporating innovative note reading technology (NoteRead™) into our error recovery process, the RBG-100 can ensure a balanced cash inventory by automatically performing a partial cassette verification as needed.

SureClear™ Configurable Cassettes

Provide efficient recycling of all six denominations or any combination of denominations.

Continuous Feed Hopper

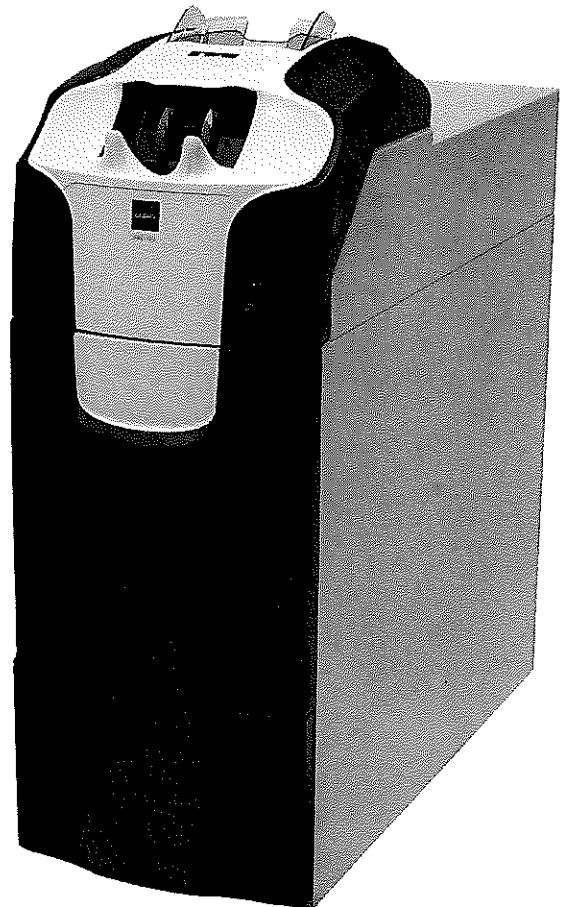
A 300 note feed provides for fast processing of large transactions without interruptions and more opportunities to engage with casino customers.

Overflow Drawer

Excess and unfit currency notes can be securely stored.

Enhanced Security

The UL-291 approved safe allows for overnight storage of cash inventory.



Capacity (Cassette or RSM)

2,700 notes/cassette x 4
1,050 + 750 notes/cassette x 1

of Denominations Recycled

6

Entrance Capacity

300/Continuous Feed

Speed (notes per second)

10

Exit Capacity

150

Temporary Reject Area

50

Total

17,100

Machine Capacity including Collection Drawer (when available)

Security

UL-291 Safe, 24 hours and alarm connectivity

Dual Users

Yes

Power Supply

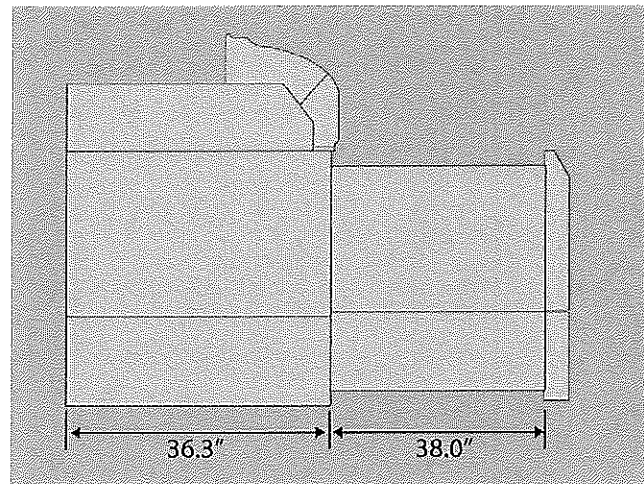
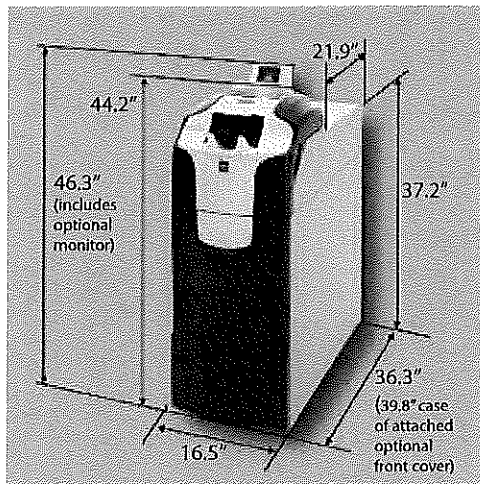
Standby: 120 Volts, 200 Watts, 1.7 Amps
Maximum: 120 Volts, 700 Watts, 5.8 Amps

Dimensions (WxDxH)

front: 16.5" x 36.3" x 46.3" (with operation monitor),
16.5" x 36.3" x 44.2" (without operation monitor) back: 16.5" x 36.3" x 37.2"

Weight

1,041 lbs



Specifications and design subject to change without notice. Please carefully read the instruction manual to ensure correct usage.

Glory Global Solutions is part of GLORY LTD. "GLORY" is a trademark of GLORY Ltd. All trademarks are owned by the GLORY Limited Group of companies. © Glory Global Solutions Limited 2013.



www.gloryglobalsolutions.com
www.gloryquality.com

Glory Global Solutions

2441 Warrenville Road, Suite 100, Lisle, IL 60532
Tel: +1 (630) 577-1015 / Fax: +1 (630) 577-1270

System Product Engineering and Support Center

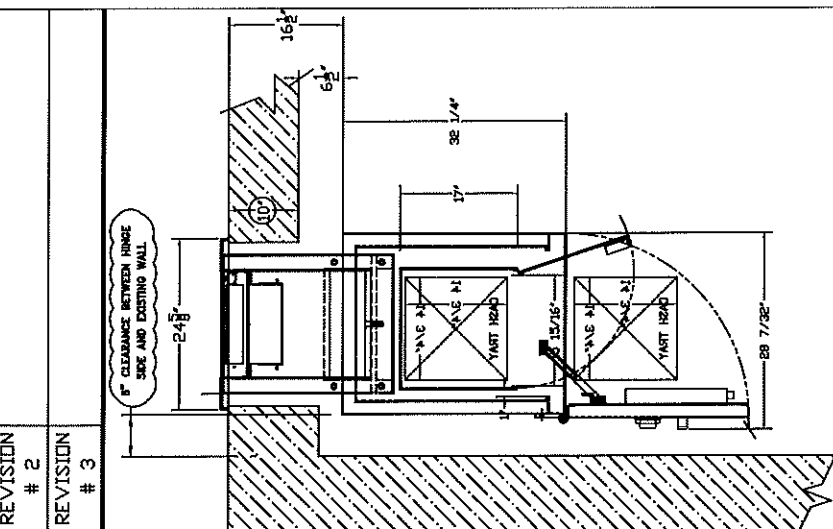
11205-A Knott Avenue, Cypress, CA 90630
Tel: +1 (800) 897-1879 / Fax: +1 (714) 897-9415

Nevada Region

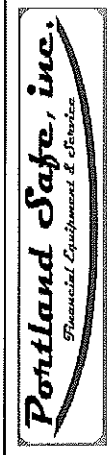
2057 E. Mañe Avenue, Las Vegas, NV 89119
Tel: +1 (888) 439-8262 / Fax: +1 (702) 252-0645

Distributed by:

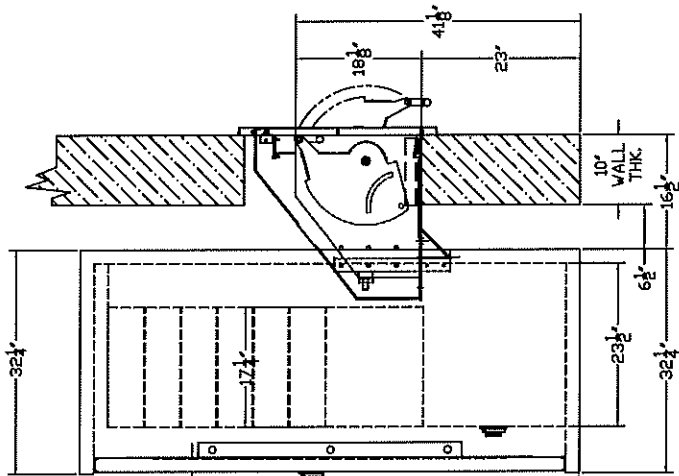
REVISION # 1	5-16-17 changed door swing , interior options
REVISION # 2	
REVISION # 3	



PLAN VIEW W/DOOR OPEN 90°



DEALER : PORTLAND SAFE , INC.
 DATE : 5-5-17
 ORDER NUMBER : QUOTE
 DRAWING NUMBER : 399333
 DRAWN BY : JOSH STEWART
 SHEET 1



RIGHT SIDE ELEVATION

DEPOSITORY HEAD:
 1 = 80UC UL LISTED NIGHT DEPOSITORY HEAD
 1 = STANDARD HOUSING (bolt on)

COMPOSITE CHEST - 72"H x 26"W x 32 1/4"D;
 TL-15; LEFT SWING

Securam Prologic L02 SRS-6 LOCK ON CHEST DOOR

ALARM:
 1 = HEAT SENSOR AND DOOR CONTACT
 1 = ALARM HOLE

BUILT IN INTERIOR LOCKERS
 PAINTED TO MATCH CHEST FINISH

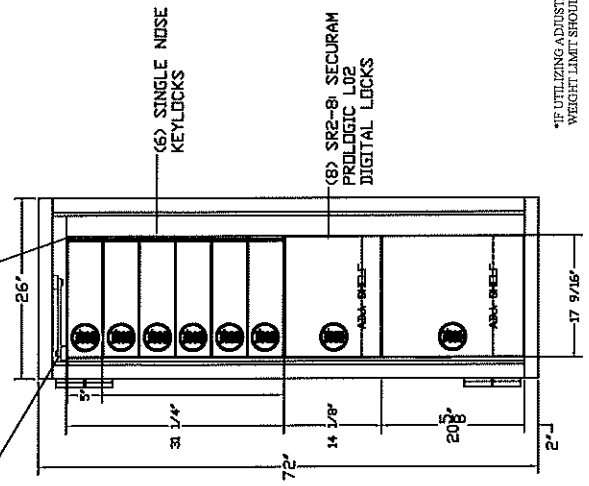
INTERIOR DOOR STOP

(2) anchor holes in bottom of chest

COLOR: CHARCOAL GRAY

EST. WEIGHT: 3,074 LBS.

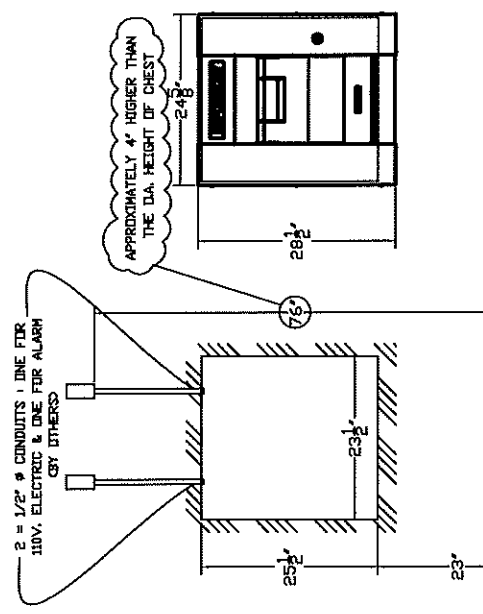
INTERNAL DOOR STOP TO STOP DOOR AT 90° TO STOP DOOR FROM REVERSED FROM CHEST DOOR SWING TO ALLOW ACCESS TO CASH TRAYS



FRONT ELEVATION
 SHOWN WITH OUTER DOOR REMOVED

IF UTILIZING ADJUSTABLE SHELVES WEIGHT LIMIT SHOULD NOT EXCEED 60LBS

2 = 1/2" # 9 CONDUITS , ONE FOR 110V. ELECTRIC & ONE FOR ALARM OR OTHERS



MASONRY DETAIL

EXTERIOR

HAMILTON SAFE

SERVICING AREAS - MINIMUM - SINGLE ATM

This is the **minimum** area required for operating and servicing the ATM.






Wherever possible the ATM should be installed within the optimum servicing area. Installing the ATM in the minimum servicing area may increase the servicing and/or upgrading time.

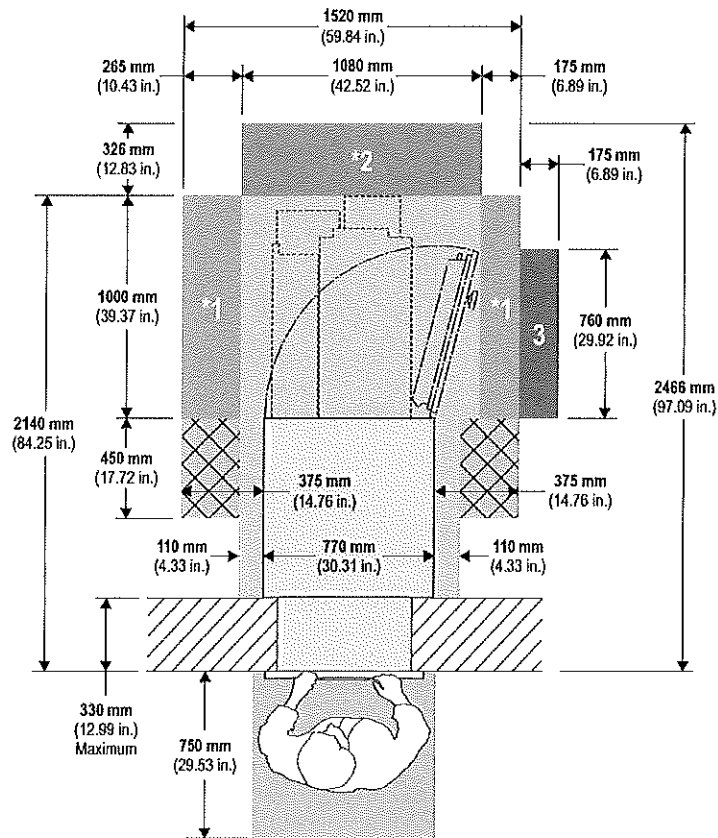
If the minimum area is not available then consult your local service representative. Every site is different and you may still be able to install the ATM but with further increases to servicing and/or upgrading time.

If you install in the minimum area then note that doors can open, and devices rack out, beyond the area shown. Always leave as much space as possible around the ATM to facilitate safe operation and servicing.

Long Sleeve

Minimum clearance area is composed of:

-  Basic clearance
-  Mandatory left OR right
-  OR 
-  If the UPS is located in the safe enclosure



CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

00006

BANK EQUIPMENT

SECTION 001100 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Project information.
- 2. Work covered by Contract Documents.
- 3. Owner-furnished products.
- 4. Access to site.
- 5. Work restrictions.
- 6. Miscellaneous provisions.

- B. Related Requirements:

- 1. Section 015000 "Temporary Facilities and Controls" for temporary facilities including utilities, support facilities, security and protection.

1.3 PROJECT INFORMATION

- A. Project Identification: cPort Credit Union, GTA #010416.

- 1. Project Location: 50 India Street, Portland, Maine

- B. Owner: cPort Credit Union

- 1. Owner's Representative: Gene Ardito, cPort Credit Union, P O Box 777, Portland, Maine

- C. Architect: Gawron Turgeon Architects, 29 Black Point Road, Scarborough, Maine 04074.

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

- 1. Allied Engineering, Structural Engineering, MEP Engineering, 160 Veranda Street, Portland, Maine

- E. Owner's Consultants

- 1. Blais Civil Engineers, 27 Gorham, Road, Gorham, Maine

- E. Contractor: Landry French Construction Company, 160 Pleasant Hill Road, Scarborough, Maine has been engaged as Contractor for this Project.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:

- 1. A new, 4-story mixed use building for cPort Credit Union will be designed and built at the corner of Middle and India Streets. The branch will be pedestrian based with an exterior ATM

The footprint will be approximately 1600 sf per floor. cPort will occupy the first two floors with teller pods, offices, work rooms, conferencing space, stair and elevator. The upper two floors are planned for residential use accessed by stairs and elevator. A roof top deck is also planned.

- B. Type of Contract:

- 1. Project will be constructed under a single prime contract.
 - a. cPort Credit Union, 50 India Street, Portland, Maine.

1.5 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

- B. Owner-Furnished Products:

- 1. Fire Alarm/Security Systems and Communication Systems from Owner Sub-Contractor.
- 2. Bank Equipment, refer to Specification Section 00007.

1.6 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

- B. Use of Site: Limit use of Project site to work areas as shown on civil drawings. Do not disturb portions of Project site beyond areas in which the Work is indicated.

- 1. Limits: Confine construction operations to areas shown as "Limit of Work" on the sitel drawings.

2. Walkways and Entrances: Keep sidewalks and entrances serving premises clear and available to public and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Provide pedestrian safety measures as required for circulation around the construction site.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to normal business working hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated.
 1. Weekend Hours: 8:00 a.m. to 4:00 p.m.
 2. Hours for Utility Shutdowns: Coordinate with cPort Credit Union and city Agencies
- C. Nonsmoking Building: Smoking is not permitted within the building or within **5 feet** of entrances, operable windows, or outdoor-air intakes.
- D. Controlled Substances: Use of tobacco products and other controlled substances on the project site are not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

END OF SECTION 001100

SECTION 012100 - ALLOWANCES

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.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Testing and inspecting allowances.
- C. Related Sections include the following:
 - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
 - 2. Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
 - 3. Divisions 2 through 33 Sections for items of Work covered by allowances.

1.03 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.04 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.05 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.06 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance less any applicable trade discounts, and shall include taxes, freight, and delivery to Project site, costs for receiving and handling at Project site, labor and installation.
 - 1. Labor rates to be actual cost only, overhead and profit carried in the contractor's base bid amount.
- B. Contractor's overhead and profit shall be included as part of the Contract Sum and not part of the allowance.

1.07 TESTING AND INSPECTING ALLOWANCE NUMBER ONE

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.08 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.02 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.03 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump-Sum Allowance: Include the sum of \$10,000.00 for furnishing plantings.

END OF SECTION 012100

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

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

1.4 PROCEDURES

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
 - 1. Description: Unsatisfactory soil excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required.
 - 2. Unit of Measurement: Cubic yard of soil excavated, based on survey of volume removed.
 - 3. Quantity allowance: Coordinate unit price with allowance adjustment requirements in section 012100 "allowances".
- B. Unit Price No. 2: rock excavation and replacement with satisfactory soil material.
 - 1. Description: Classified rock excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required.
 - 2. Unit of Measurement: Cubic yard of rock excavated, based on survey of volume removed.
 - 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012000 "Allowances".
- C. Unit price No. 3: Provide one ton of bituminous paving.
 - 1. Description: Prepare, supply and install one ton of blacktop paving.
 - 2. Unit of measurement: Metric Ton.
- D. Unit price No. 4: Provide 120V Duplex Wall Outlet.
 - 1. Description: Supply materials and labor for complete outlet matching adjacent receptacles.
- E. Unit price No. 5: Telephone/Data Dual Jack Outlet
 - 1. Description: supply material and labor for complete outlet including empty conduit with pull wire above ceiling.
- F. Unit Price No. 6: 2 x 2 Recessed LED Light Fixture
 - 1. Description: Supply material and labor for fixtures as described in the drawings.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
 - 2. Hold pricing for 90 days from date of bid to allow Owner time for project accounting. Alternates not accepted before contract signing may be added by Change Order later.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section.

PART 2 - PRODUCTS (Not Used)

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Add Alternate #1 – Sageglass – Contact Francis O’Neil – 207/206-5540
- B. Add Alternate #2 – Solarban 90 Starphire – Insulated Glass Unit.

END OF SECTION 012300

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.
 - 2. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 20 days after receipt of Proposal Request or earlier as specified in Proposal Request issued, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include quotes on supplier's and subcontractor's letterhead for the requested change.
 - e. Unless indicated otherwise in the proposal request, proposed changes shall be done within the original completion schedule. If the extent of the change cannot be done within the original completion schedule, include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float time before requesting an extension of the Contract Time.

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float time before requesting an extension of the Contract Time.
 6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests, or format as approved by the Owner.

1.5 ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
1. Include installation costs in purchase amount only where indicated as part of the allowance.
 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 21 days after such authorization.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order form for signatures of Owner and Contractor on AIA Document G702-1992.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "Unit Prices" for administrative requirements governing use of unit prices.
 - 3. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
 - 1. Cover Sheet Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.

- d. Contractor's name and address.
- e. Date of submittal.
- f. Certification that Record Drawings have been updated and verified.
2. Submit draft of AIA Document G703 Continuation Sheets
3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents, providing at least one line item for each Specification Section. Provide several line items for principal subcontract amounts, where appropriate.
5. For Division 22 and 23 work, provide the following additional line item breakdown of the mechanical subcontractor's work for each Application for Payment:
 - a. Ductwork Systems.
 - b. HVAC Piping Systems.
 - c. HVAC Equipment.
 - d. HVAC Controls.
 - e. Plumbing, including fixtures and piping.
6. Documentation: Submit proper documentation for the amounts being requisitioned from subcontractors and material suppliers with each Application for Payment.
7. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
8. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
 - b. Only major long lead delivery items may be considered for off-site storage (Example: Long lead custom mechanical unit). Standard order and production materials and products shall be delivered to the site before including in Application of Payment on such items.
9. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
10. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
11. Each item in the Schedule of Values and Applications for Payment shall be complete.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place shall be shown as separate line items in the Schedule of Values.

12. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

C. The Contractor shall furnish to the Architect at the beginning of the project an expected monthly requisition estimate for the Owner's use in planning funding.

1.5 APPLICATIONS FOR PAYMENT

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

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Progress Payment Applications shall be submitted to Architect by the 25th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

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

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

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.

2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit draft copies of each Application for Payment to the Architect and Owner seven days before the scheduled monthly meeting for review and comment. The architect will assemble the comments from the reviewers and communicate with the Contractor regarding requested revisions.

1. Monthly Application: Submit 4 signed and notarized original copies of each Application for Payment reflecting agreed upon comment revisions to Architect by a method ensuring receipt with-in 24 hours before the monthly project meeting. One copy shall include waivers of lien and similar attachments.

2. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

3. Submit one electronic copy of Application for Payment.

F. Partial and Final Lien Waivers: With each Application for Payment, submit partial and final lien waivers from every entity including Contractor, subcontractors, sub-subcontractors, and vendors/suppliers who could lawfully and possibly file a lien in excess of \$500 arising out of the Contract, and related to work covered by the payment for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.

2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

 4. Upon final payment, submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit waivers of lien on form shown at the end of this section, labeled as "Contractor, Sub-Contractor and Major Supplier Affidavit and Lien Waver," or other form acceptable to Owner.

 6. Lien Waiver Summary Form: Submit a Lien Waiver Summary Sheet with each payment requisition, displaying the Schedule of Values (or construction activity), the contractor, sub-contractor, and suppliers, and the lien waiver amount for the current requisition. The Lien Waiver Summary shall also include the cumulative lien waiver totals for each schedule of value item.
- G. Record Drawing Updates: With each Application of Payment, record documents shall be maintained and current for all trades, available for viewing at a central location.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Schedule of unit prices.
 5. Submittals Schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. Copies of building permits and other required permits.
 8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 9. Initial progress report.
 10. Report of preconstruction conference.
 11. Certificates of insurance and insurance policies.
 12. Performance and payment bonds.
- I. Progress Applications for Payment: Administrative actions and submittals that must precede or coincide with submittal of progress Applications for Payment include the following:
1. Contractor's Construction Schedule update.
 2. Submittals for Work being requisitioned for are complete and approved.
 3. Submit list of completed tests, checklists, commissioning, reports, and similar requirements for the work are submitted and in compliance with the Contract Documents.
 4. Minutes of previous month's progress meeting have been distributed.
 5. Record drawings are current.
- J. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion less retainage, for

portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

 3. Include occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner's full access and use of completed work.
 4. Final cleaning of the work.
 5. Advice to Owner on coordination of shifting insurance coverages, including proof of extended coverages as required.
 6. Listing of Contractor's incomplete work, recognized as exceptions to Architect's certificate of substantial completion.
- K. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements, record documents, operation and maintenance data, and demonstration and training.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G707, "Consent of Surety to Final Payment."
 6. Evidence that claims have been settled.
 7. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
- L. Lien Waivers: If a subcontractor refuses to furnish a release of waiver required by the Owner, the Contractor shall furnish a bond satisfactory to the Owner to indemnify the Owner against such a lien. If such a lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien including all costs and reasonable attorney fees.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

**CONTRACTOR, SUB-CONTRACTOR AND MAJOR SUPPLIER AFFIDAVIT AND LIEN
WAIVER**

TO ACCOMPANY EACH PAYMENT REQUISITION

To: _____ ("Owner") and _____ ("Lender") State of
Maine, County of _____

I _____, being duly sworn, deposes and says that he makes this
affidavit for and on behalf of _____ who is the Contractor Sub-Contractor,
Major Supplier, (circle one), under a contract with the Owner, Contractor, Sub-Contractor, (circle one),
for the construction or reconstruction of buildings and other improvements upon real estate of the
Owner located on _____
_____, Maine (the "Project"), that all Contractor's subcontractors and
materialmen have been paid in full, less proper contract retainages, if any, for labor, services, and
material furnished through the cut-off date of the prior requisition.

Further more, the Contractor, Sub-Contractor, Major Supplier (circle one) upon receipt of
\$ _____ does hereby waive and release any and all liens and claims and rights to lien
on the Project which it may have for labor, services and materials
furnished to the Project* through _____ (the cut-off date for the requisition) and states
that all of its labor has been paid through that date.

*Except to the extent of retainage due \$ _____.

By: _____

Its: _____

Sworn to and subscribed before me this _____ day of _____, 20_____

Notary Public

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Administrative and supervisory personnel.
 - 2. Project meetings.
- B. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 2. Division 01 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical. Coordinate location of pipes, conduits, ducts, light fixtures and similar items in confined areas to assure proper fit and access. Contractor is responsible for handling interferences created by the work of subcontractors (example, sprinkler pipe interfering with installation of duct work; duct work interfering with installation of light fixtures).
 - 5. Coordinate the work to provide smoke and fire seals for component interfaces and penetrations of smoke walls and fire rated construction.
- B. Coordination Drawings: Prepare Coordination Drawings as determined by the Contractor and subcontractor, if limited space availability necessitates maximum utilization of space for

efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate required installation sequences.
 2. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
 2. Preparation of the Schedule of Values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
 9. Project closeout activities.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
- 1.4 SUBMITTALS
- A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
1. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for requests for interpretations (RFIs).
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.

- v. Progress cleaning/dust control.
 - w. Working hours.
 - x. Project smoke free policy requirements and notification signage requirements.
3. Minutes: Record and distribute meeting minutes.
- a. Include action items and responsible party.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. The Contract Documents.
 - b. Options.
 - c. Related requests for interpretations (RFIs).
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - z. Record drawing process.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - a. Include action items and responsible party.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded.

Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

- D. Project/Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Application for Payment (Monthly): Contractor shall bring copy of Application for Payment to meetings on a monthly basis. Review Application for Payment and required attachments, including record drawing and documents status, waivers of mechanic's liens, list of completed tests, checklists, commissioning, reports, and similar requirements for the work are submitted and in compliance with the Contract Documents.
 - c. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Requests for interpretations (RFIs).
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 3. Minutes: Record and distribute the meeting minutes.
 - a. Include action items and responsible party.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

- a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Coordination/Progress Meetings: Conduct Project coordination/progress meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
 3. Conduct coordination meetings with the mechanical, plumbing, sprinkler and electrical trades. Before the trades start work in an area of the building, review structural clearances and locations of ducts, pipes, conduits, light fixtures, equipment and other items that affect location and proper fit. Verify depths and clearances before fabrication of ductwork.
 4. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
 - a. Include action items and responsible party.

PART 2 - PRODUCTS (Not Used)

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
 - 4. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
 - 5. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 6. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 7. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Divisions 02 through 33 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 days minimum for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 10 days minimum for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 days minimum for initial review of each submittal.
- D. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on submittals. Mark with dark colored pen that permits photocopying. Do not use highlighter.
- F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Transmittal number, numbered consecutively.
 - k. Submittal and transmittal distribution record.
 - l. Remarks.
 - m. Signature of transmitter.
 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are approved.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating approval taken by Architect.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
1. Mark with dark colored pen that permits photocopying. Do not use highlighter.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed

- data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a.. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 4. Submit Product Data before or concurrent with Samples.
 5. Number of Copies: Submit three copies of Product Data, unless otherwise indicated. Architect will return one copy for reproduction and distribution. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.

3. Number of Copies: Submit three opaque copies of each submittal. Architect will retain two copies; Architect will return one copy for reproduction and distribution. Mark up and retain one returned copy as a Project Record Drawing and copies where copies are required for operation and maintenance manuals.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is

inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product.
 - 2. Number and name of room or space.
 - 3. Location within room or space.
 - 4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return one copy for reproduction and distribution.
 - a. Mark up and retain one returned copy as a Project Record Document.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- H. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return one copy.
 - a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 1. Name of evaluation organization.
 2. Date of evaluation.

3. Time period when report is in effect.
 4. Product and manufacturers' names.
 5. Description of product.
 6. Test procedures and results.
 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads.
Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- S. Manufacturer's Instructions: Where the specifications require installation according to manufacturer's recommendations, guidelines, and procedures, submit requirements at the same time Action Submittals are made. Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
- T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as

applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner at end of the project; do not submit to Architect. Maintain copy at the site for the duration of the construction.
1. Architect will not review submittals that include MSDSs and will return them.

2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
 - 1. The Contractor shall review submittals for completeness and compliance with the Contract Documents. If submittal contains substitutions, Contractor shall process substitutions in accordance with Division 01 Section "Substitutions and Product Options," and not part of specified Shop Drawings or Product Data submittals. Contractor is responsible for keeping Subcontractors on time with the submittal schedule. If the Contractor submits submittals that are repeatedly rejected, requiring the Architect to perform multiple reviews of the same submittal because of the failure to properly prepare and complete the submittals:
 - a. Owner will compensate Architect for such additional services.
 - b. Owner will deduct the amount of such compensation from the final payment to the Contractor.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows or with similar verbiage:
 - 1. Final Unrestricted Release: Where the submittals are marked as follows, the work covered by the submittal may proceed provided it complies with the requirements of the contract documents; acceptance of the work will depend upon that compliance.
 - a. Marking: "Reviewed" or "Approved."
 - 2. Final-But-Restricted Release: When the submittals are marked as follows, the work covered by the submittal may proceed provided it complies with both the Architect's/Engineer's notations or corrections on the submittal and with the requirements of the contract documents; acceptance of the work will depend on that compliance.
 - a. Marking: "Make corrections noted" or "Approved as Noted."
 - 3. Returned for Resubmittal: When the submittal is marked as follows, do not proceed with the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise the submittal or prepare a new submittal in accordance with the Architect's/Engineer's notations stating the reasons for returning the submittal; resubmit the submittal without delay. Repeat if necessary to obtain a different action marking. Do not permit submittals with the following marking to be used at the project site, or elsewhere where work is in progress.
 - a. Marking: "Revise and Resubmit."

- b. Marking: "Rejected."
- C. The Architect's marking of "Approved," "Approved as Noted" or similar verbiage means submittal has been reviewed for general conformance to the contract documents only and does not mean unqualified acceptance. The Contractor is fully responsible for compliance with the contract documents.
- D. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- E. Partial submittals are not acceptable, will be considered non-responsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 3. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples.

- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspectng.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

- C. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. **Specialists:** Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed, unless otherwise indicated.
- K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 33.
- 1.7 QUALITY CONTROL
- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. The Owner will hire a testing agency to perform testing of materials and inspections, including the following:
 - a. Soils testing.
 - b. Concrete testing.
 - c. Mechanical and electrical commissioning.
 - d. Special Inspections: Owner will engage a qualified registered engineer to conduct special inspections required by authorities having jurisdiction as the responsibility of Owner, in compliance with applicable building code.
 2. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 3. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 4. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.

- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified registered engineer to conduct special tests and inspections required by code and by authorities having jurisdiction as the responsibility of Owner, in compliance with applicable building code.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- 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.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 12. AGA - American Gas Association; www.aga.org.
 - 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 16. AIA - American Institute of Architects (The); www.aia.org.
 - 17. AISC - American Institute of Steel Construction; www.aisc.org.
 - 18. AISI - American Iron and Steel Institute; www.steel.org.
 - 19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 - 21. ANSI - American National Standards Institute; www.ansi.org.
 - 22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 - 23. APA - APA - The Engineered Wood Association; www.apawood.org.
 - 24. APA - Architectural Precast Association; www.archprecast.org.
 - 25. API - American Petroleum Institute; www.api.org.
 - 26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).

27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPAA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.

70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
73. ECIA - Electronic Components Industry Association; www.eciaonline.org.
74. EIA - Electronic Industries Alliance; (See TIA).
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
83. FM Approvals - FM Approvals LLC; www.fmglobal.com.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
85. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarooft.com.
86. FSA - Fluid Sealing Association; www.fluidsealing.com.
87. FSC - Forest Stewardship Council U.S.; www.fscus.org.
88. GA - Gypsum Association; www.gypsum.org.
89. GANA - Glass Association of North America; www.glasswebsite.com.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
94. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
95. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
96. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
100. ICC - International Code Council; www.iccsafe.org.
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
104. IEC - International Electrotechnical Commission; www.iec.ch.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
109. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
110. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
111. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.

113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
116. ISO - International Organization for Standardization; www.iso.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
119. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
120. LMA - Laminating Materials Association; (See CPA).
121. LPI - Lightning Protection Institute; www.lightning.org.
122. MBMA - Metal Building Manufacturers Association; www.mbma.com.
123. MCA - Metal Construction Association; www.metalconstruction.org.
124. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
125. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
126. MHIA - Material Handling Industry of America; www.mhia.org.
127. MIA - Marble Institute of America; www.marble-institute.com.
128. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
129. MPI - Master Painters Institute; www.paintinfo.com.
130. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
131. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
133. NADCA - National Air Duct Cleaners Association; www.nadca.com.
134. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
135. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
136. NBI - New Buildings Institute; www.newbuildings.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
138. NCMA - National Concrete Masonry Association; www.ncma.org.
139. NEBB - National Environmental Balancing Bureau; www.nebb.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
141. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
142. NEMA - National Electrical Manufacturers Association; www.nema.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
145. NFPA - National Fire Protection Association; www.nfpa.org.
146. NFPA - NFPA International; (See NFPA).
147. NFRC - National Fenestration Rating Council; www.nfrc.org.
148. NHLA - National Hardwood Lumber Association; www.nhla.com.
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
151. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
152. NRCA - National Roofing Contractors Association; www.nrca.net.
153. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
154. NSF - NSF International; www.nsf.org.
155. NSPE - National Society of Professional Engineers; www.nspe.org.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
157. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.

158. NWFA - National Wood Flooring Association; www.nwfa.org.
159. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
160. PDI - Plumbing & Drainage Institute; www.pdionline.org.
161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
162. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
163. RFCI - Resilient Floor Covering Institute; www.rfci.com.
164. RIS - Redwood Inspection Service; www.redwoodinspection.com.
165. SAE - SAE International; www.sae.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
167. SDI - Steel Deck Institute; www.sdi.org.
168. SDI - Steel Door Institute; www.steeldoor.org.
169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
171. SIA - Security Industry Association; www.siaonline.org.
172. SJI - Steel Joist Institute; www.steeljoist.org.
173. SMA - Screen Manufacturers Association; www.smainfo.org.
174. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
177. SPIB - Southern Pine Inspection Bureau; www.spib.org.
178. SPRI - Single Ply Roofing Industry; www.spri.org.
179. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
180. SSINA - Specialty Steel Industry of North America; www.ssina.com.
181. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
182. STI - Steel Tank Institute; www.steeltank.com.
183. SWI - Steel Window Institute; www.steelwindows.com.
184. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
186. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
187. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
190. TMS - The Masonry Society; www.masonrysociety.org.
191. TPI - Truss Plate Institute; www.tpinst.org.
192. TPI - Turfgrass Producers International; www.turfgrasssod.org.
193. TRI - Tile Roofing Institute; www.tilerroofing.org.
194. UL - Underwriters Laboratories Inc.; www.ul.com.
195. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
196. USAV - USA Volleyball; www.usavolleyball.org.
197. USGBC - U.S. Green Building Council; www.usgbc.org.
198. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
199. WASTEC - Waste Equipment Technology Association; www.wastec.org.
200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
201. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.

202. WDMA - Window & Door Manufacturers Association; www.wdma.com.
203. WI - Woodwork Institute; www.wicnet.org.
204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
205. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservation.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
 - 1. Sewers and drainage.
 - 2. Water service and distribution.
 - 3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
 - 4. Heating and cooling facilities.
 - 5. Ventilation.
 - 6. Electric power service.
 - 7. Lighting.
 - 8. Telephone service.
- C. Support facilities include, but are not limited to, the following:
 - 1. Temporary drains.
 - 2. Project identification and temporary signs.
 - 3. No smoking policy and notification signage.
 - 4. Waste disposal facilities.
 - 5. Field offices.
 - 6. Storage and fabrication sheds.
 - 7. Lifts and hoists.
 - 8. Construction aids and miscellaneous services and facilities.
 - 9. Pedestrian protections
- D. Security and protection facilities include, but are not limited to, the following:
 - 1. Environmental protection.
 - 2. Pest control.
 - 3. Security enclosure and lockup.
 - 4. Barricades, warning signs, and lights.
 - 5. Temporary enclosures.
 - 6. Fire protection.
 - 7. Pedestrian protection
- E. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Division 01 Section "Construction Waste Management" for handling and processing construction debris.

3. Division 01 Section "Execution Requirements" for progress cleaning requirements.
4. Divisions 02 through 33 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 1. Owner's construction forces.
 2. Occupants of Project.
 3. Architect.
 4. Testing agencies.
 5. Subcontractors.
 6. Commissioning agent.
 7. Personnel of authorities having jurisdiction.
- B. Sewer Service: Toilet facilities will be provided by the contractor for the project.
- C. Water Service: Water for customary usage will be provided by the Contractor.
- D. Electric Power Service: Customary power usage will be provided by the Contractor.
- F. Telephone and Internet Service: Make arrangements for internet connection. Telephone service for Contractor's Office will be part of Contractor's costs.
- G. Fuel, power and other utility charges incurred for testing and start-up of equipment shall be paid for by the Contractor as part of the work.

1.5 SUBMITTALS

- A. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements to protect install concrete.

1.6 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. The Contractor is responsible for the implementation, monitoring, and maintenance of job site safety program for the duration of the contract.

1.7 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
 - 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 - 1. Keep temporary services and facilities clean and neat.
 - 2. Relocate temporary services and facilities as required by progress of the Work.
- C. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site. Construction noise from machinery, equipment, construction traffic, hammering and similar loud noises shall be restricted to the hours of 7:00 a.m. to 4:00p.m. Obey State and local noise ordinances.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
- C. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- D. Water: Potable.

2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
- B. Field Offices: Prefabricated, mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
- F. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide gas/oil fired space heaters that are UL labeled and approved for construction space heating by appropriate agency. Provide adequate ventilation and thermostatic control. Heaters shall be located outside the building and combustion gases shall be vented outside the building. Maintain observation of units in operation.
 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
- G. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- H. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.
- I. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION AND OPERATION

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 1. Arrange with the Governing Agencies for time when service can be interrupted, if necessary, to make connections for temporary services.
 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.

- B. Water Service: Water service and distribution piping in sizes and pressures adequate for construction.
- C. Sanitary Facilities: Provided by the Contractor.
 - 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 - 2. Toilets: Provided by the Contractor.
 - 3. Drinking-Water Facilities: Provided by Owner on premises
- D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Temporary heating units shall be indirect fired units vented to the exterior. Use of direct fired fossil fuel fired units is not permitted.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- F. Temporary Electric Power Service : Provided by the Contractor
- G. Temporary Lighting: Provide temporary lighting with local switching.
 - 1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions. A minimum of 80 foot candles shall be supplied at mid-height of surfaces for taping, painting and finish work.
- H. Telephone and Internet Service: Contractor to provide temporary telephone. High-speed internet service throughout construction period will be provided by the Contractor.
 - 1. Provide additional telephone lines for the following:
 - a. Provide two separate telephone lines.
 - b. Provide internet/e-mail connection and service.
 - 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Owner's office.
 - f. Principal subcontractors' field and home offices.
 - 3. Provide an answering machine on superintendent's telephone.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Locate field offices on site.

2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Roads and Parking Areas: Locate parking for construction staff.
- C. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated. Include name of project, and names of Owner, Architect and Contractor.
 2. Prepare temporary signs to provide directional information to construction personnel and visitors.
 3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in size of 4 by 8 feet and 3/4 inch thickness, unless otherwise indicated. Support on posts or framing of preservative-treated wood or steel.
 4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
 5. See sign criteria.
- G. No Smoking Policy: No smoking policy during construction as directed by the Owner.
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.
1. See Division 01 Section "Construction Waste Management and Disposal" for additional requirements.
 2. Each trade shall pick up the debris and rubbish generated by that trade and dispose of in the appropriate dumpsters furnished by the Contractor.
- I. Contractor's Field Office: The Contractor is responsible for establishing the field office.
1. Furnishings: The Contractor shall provide all furniture, including desks, chairs, plan racks, file drawers, computers and software, photocopiers, waste receptacles, answering machine, conference room table and chairs for their office and conference room,
- 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION
- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

- B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas within the building. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- C. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights
- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 4. Install tarpaulins securely using wood framing and other materials.
 5. Provide temporary enclosures for exterior concrete, masonry, and other trades requiring heat, so as to properly protect Work and maintain specified temperatures. Coordinate types of staging being used by the subcontractors that will require enclosures.
 6. Provide enclosures for artificial shade and wind breaks as required for hot weather protection of concrete placements and masonry. Coordinate with the subcontractors.
- E. Secured Temporary Fire Rated Dust Partitions:
7. Provide secured temporary fire rated dust protection isolating the work from occupied spaces before starting any demolition and remove after work is completed.
 8. Construct secured temporary fire rated dust protection out of metal studs and fire-retardant vinyl and adequately supported sealed with duct tape.
- F. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure -type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.

4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
7. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
 3. Snow removal: Provide snow removal at drives, parking, areas necessary to do the work, maintain access to materials, temporary facilities and offices.
- C. Flooring Protection: Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during construction period. Use protection methods indicated or recommended by flooring manufacturer.
 1. Cover flooring with undyed, untreated building paper at high traffic areas until inspection for Substantial Completion.
 2. Do not move heavy and sharp objects directly over flooring. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- D. Restoration of Roadways and Pavement: Roadways, pavements and curbs that are broken, damaged, settled, or otherwise defective as a result of receiving, handling, storage of materials or the performance of any work under this Contract, shall be fully restored to the satisfaction of the authorities having jurisdiction.
- E. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

- F. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015719 – INDOOR AIR QUALITY (IAQ) MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Special requirements for Indoor Air Quality (IAQ) management during construction operations.
 - a. Control of emissions during construction.
 - b. Moisture control during construction.
 - 2. Procedures for testing baseline IAQ. Baseline IAQ requirements specify maximum indoor pollutant concentrations for acceptance of the facility.
- B. Related Sections:
 - 1. 01 31 00 - Project Management and Coordination.
 - 2. 01 40 00 – Quality Requirements: Meetings and project coordination.

1.2 DEFINITIONS

- A. Definitions pertaining to sustainable development: As defined in ASTM E2114.
- B. Adequate ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of particulates, dust, fumes, vapors, or gases.
- C. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.
 - 1. Hazardous materials include: pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).
- D. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.
- E. Interior final finishes: Materials and products that will be exposed at interior, occupied spaces; including flooring, wallcovering, finish carpentry, and ceilings.
- F. Packaged dry products: Materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.
- G. Wet products: Materials and products installed in wet form, including paints, sealants, adhesives, special coatings, and other materials which require curing.

1.3 SUBMITTALS

- A. Indoor Air Quality (IAQ) Management Plan: Not less than 10 days before the Pre-construction meeting, prepare and submit an IAQ Management Plan including, but not limited to, the following:
 - 1. Procedures for control of emissions during construction.
 - a. Identify schedule for application of interior finishes.
 - 2. Procedures for moisture control during construction.
 - a. Identify porous materials and absorptive materials.
 - b. Identify schedule for inspection of stored and installed absorptive materials.
 - 3. Revise and resubmit Plan as required by Owner.
 - a. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
- B. Product Data:
 - 1. Submit product data for filtration media used during construction and during operation. Include Minimum Efficiency Reporting Value (MERV).
 - 2. Material Safety Data Sheets: Submit MSDSs for inclusion in Operation and Maintenance Manual for the following products. Coordinate with Section 01 78 23
 - a. Adhesives.
 - b. Floor and wall patching/leveling materials.
 - c. Caulking and sealants.
 - d. Insulating materials.
 - e. Fireproofing and firestopping.
 - f. Carpet.
 - g. Paint.
 - h. Clear finish for wood surfaces.
 - i. Lubricants.
 - j. Cleaning products.
- C. Inspection and Test Reports:
 - 1. Moisture control inspections.
 - 2. Moisture content testing.
 - 3. Moisture penetration testing.
 - 4. Microbial Growth testing.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 IAQ MANAGEMENT - EMISSIONS CONTROL

- A. During construction operations, follow the recommendations in Sheet Metal and Air conditioning contractors IAQ Guidelines for Occupied Buildings under Construction.
- B. HVAC Protection:
 - 1. Seal return registers during construction operations.
 - 2. Provide temporary exhaust during construction operations
 - 3. To the greatest extent possible, isolate and/or shut down the return side of the HVAC system during construction. When ventilation system must be operational during construction activities, provide temporary filters.
- C. Source Control: Provide low and zero VOC materials as specified.

- D. Pathway Interruption: Isolate areas of work as necessary to prevent contamination of clean or occupied spaces. Provide pressure differentials and/or physical barriers to protect clean or occupied spaces.
- E. Housekeeping: During construction, maintain project and building products and systems to prevent contamination of building spaces.
- F. Temporary Ventilation: Provide an ACH (air changes per hour) of **[1.5]** or more and as follows:
 - 1. Provide adequate ventilation during and after installation of interior wet products and interior final finishes.
 - 2. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 during construction **[and during Owner occupancy]**. Coordinate with work of Division 23 (15), Heating Ventilating and Air Conditioning (HVAC).
- G. Scheduling: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible.
- H. Flush-Out: After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%.

3.2 IAQ MANAGEMENT - MOISTURE CONTROL

- A. Housekeeping:
 - 1. Keep materials dry. Protect stored on-site and installed absorptive materials from moisture damage.
 - 2. Verify that installed materials and products are dry prior to sealing and weatherproofing the building envelope.
 - 3. Install interior absorptive materials only after building envelope is sealed and weatherproofed.
- B. Inspections: Document and report results of inspections; state whether or not inspections indicate satisfactory conditions.
 - 1. Examine materials for dampness as they arrive. If acceptable to Architect/Owner, dry damp materials completely prior to installation; otherwise, reject materials that arrive damp.
 - 2. Examine materials for mold as they arrive and reject materials that arrive contaminated with mold.
 - 3. Inspect stored and installed absorptive materials regularly for dampness and mold growth.
 - a. Where stored on-site or installed absorptive materials become wet, notify **[Architect]**. Inspect for damage. If acceptable to Architect, dry completely prior to closing in assemblies; otherwise, remove and replace with new materials.
 - 3. Basement: Monitor basement and crawlspace humidity, and dehumidify when relative humidity is greater than 85 percent for more than 2 weeks or at the first sign of mold growth.
 - 4. Site drainage: Verify that final grades of site work and landscaping drain surface water and ground water away from the building.
 - 5. Weather-proofing: Inspect moisture control materials as they are being installed. Include the following:

- a. Air barrier: Verify air barrier is installed without punctures and/or other damage. Verify air barrier is sealed completely.
 - b. Flashing: Verify correct shingling of the flashing for roof, walls, windows, doors, and other penetrations.
 - c. Insulation layer: Verify insulation is installed without voids.
 - d. Roofing: In accordance with ASTM D7186 Standard Practice for Quality Assurance Observation of Roof Construction and Repair
6. Plumbing: Verify satisfactory pressure test of pipes and drains is performed before closing in and insulating lines.
 7. HVAC: Inspect HVAC system as specified to verify.
 1. **condensate pans are sloped and plumbed correctly;**
 2. **access panels are installed to allow for inspection and cleaning of coils and ductwork downstream of coils;**
 3. **ductwork and return plenums are air sealed;**
 4. **duct insulation is installed and sealed; and**
 5. **chilled water line and refrigerant line insulation are installed and sealed.]**
- C. Schedule:
1. Schedule work such that absorptive materials, including but not limited to porous insulations, paper-faced gypsum board, ceiling tile, and finish flooring, are not installed until they can be protected from rain and construction-related water.
 2. Weather-proof as quickly as possible. Schedule installation of moisture-control materials, including but not limited to air barriers, flashing, exterior sealants and roofing, at the earliest possible time.
- D. Testing for Moisture Content: Test moisture content of porous materials and absorptive materials to ensure that they are dry before sealing them into an assembly. Document and report results of testing. Where tests are not satisfactory, dry materials and retest. If satisfactory results cannot be obtained with retest, remove and replace with new materials.
1. Concrete: **[Moisture test prior to finish flooring application as specified in Division 09.]**
 2. Wood: Moisture test as per ASTM D4444 - Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters; unless otherwise indicated acceptable upper limits for wood products are < 20% at center of piece; < 15% at surface.
 3. Gypsum Board, Gypsum Plaster, Insulation, and other absorptive materials: Moisture test with a Pinless Moisture Meter to assess patterns of moisture, if any.

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 01 Section "Alternates" for products selected under an alternate.
 - 2. Division 01 Section "References" for applicable industry standards for products specified.
 - 3. Division 01 Section "Substitutions and Product Options" for procedures and requirements for product substitutions.
 - 4. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
 - 5. Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Store cementitious products and materials on elevated platforms.
 - 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 7. Protect stored products from damage and liquids from freezing.
 - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products. Where a product, material, or equipment is specified by name, all features of the named product apply, whether specifically listed or not in the specification description.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Division 01 Section "Substitutions and Product Options" to obtain approval for use of an unnamed product.

- a. Whenever a product, material or equipment is defined by describing a proprietary product, or by using the name of a manufacturer, the term "Or Approved Equal", if not inserted, shall be implied. The specific article or material mentioned shall be understood to establish minimum standards, as to the type, function, standard of design, durability, efficiency and quality desired and shall not be construed to exclude other manufacturers' products of comparable quality, design and efficiency.
- 1) Materials and models of items, which the Contractor alleges to be equal to the materials and methods of items named in the specifications, shall be subject to the written approval by the Architect, and will be issued by addendum. If the alleged equals are to receive consideration in the bid award, written approval shall be received from the Designer at least ten days prior to the established bid opening dates. The materials or equipment shall be sufficiently described to enable the Designer to easily identify salient features. The Architect's approval or rejection of a proposed substitution shall be final. The use of substitution items will not be permitted without the approval of the Architect. See Division 01 Section "Substitutions and Product Options" for procedures to obtain approval for use of an unnamed product, material or equipment.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. See Division 01 Section "Substitutions and Product Options" for substitution procedures and requirements.
- B. In the event substitutions are proposed by the Contractor to the Architect after contract signing, the Architect will record all time involved by the Architect and Architect's consultants for the review and evaluation of the proposed substitutions.
 1. The Architect will bill the Owner at the rate of 2-1/2 times the direct cost to the Architect and Architect's consultant's time.
 2. Owner will compensate Architect for such additional services.
 3. Owner will deduct the amount of such compensation from the final payment to the Contractor.
 4. Architect and Architect's consultants will be compensated regardless whether substitution is approved or rejected.
- C. If differences discovered later that were not identified on the substitution request are found that make the substitution unacceptable, it will be reason for rejection and replacement, irregardless if the substitution has been delivered, or installed, at no additional cost to the Owner.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 016300 - SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Substitution procedures during the bid period shall be followed to provide equality of bids. Substitutions not approved by addendum shall not be included in the bid. The Architect and Owner will not consider substitutions submitted after bids are received. Contractors submitting substitutions after bids are received will not be given additional compensation for rejected submittals.

1.2 SUBSTITUTIONS

- A. Submit two copies of request for substitution. Include in the request:
1. Complete data substantiating compliance of proposed substitution with Contract Documents.
 2. For Products:
 - a. Product identification including manufacturer's name and address.
 - b. Manufacturer's Literature:
 - (1) Product description.
 - (2) Performance and test data.
 - (3) Reference standards.
 - c. Samples.
 - d. Name and address of similar projects on which product was used, and date of installation.
 3. Itemized comparison of product substitution with product specified.
 4. Changes in construction schedule.
 5. Accurate cost data on proposed substitution in comparison with product specified.
- B. In Making Request for Substitution, the Contractor Represents:
1. Contractor has investigated proposed product or method and determined that it is equal or superior in all respects to that specified.
 2. Contractor will provide the same or greater guarantee for substitution as for product specified.
 3. Contractor will coordinate installation of accepted substitution into work, making such changes as required for work to be completed.
 4. Contractor waives all claims for additional costs related to substitution in which it becomes apparent before, during or after installation.
 5. Requested substitution is compatible with other portions of the Work. All sizes, dimensions, locations for connections to other items as designed, clearances from building structure and other equipment have been verified and is acknowledged in the substitution request.
 6. Contractor requesting substitution shall bear additional costs to all parties due to his substitution, including Architect's fees.

- C. Substitutions Will Not Be Considered If:
1. They are indicated or implied on shop drawings or project submittals without formal request.
 2. Acceptance will require substantial revision of Contract Documents.
 3. Not readily serviceable in the area or may cause the Owner to stock extra parts.
- D. Substitutions not approved before the last addendum is distributed shall not be considered in the Base Bid.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 016300

SUBSTITUTION REQUEST FORM

Project: _____ Substitution Request Number: _____
To: _____ From: _____
Re: _____ Date: _____
Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No. _____

Attached data includes product description, specifications, drawings, cost data, and performance and test data adequate for evaluation of the request: applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitutions will require for its proper installation.

Attached data includes a detailed itemized comparison list of product substitution with product specified.

The Undersigned certifies:

1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the Substitution as for the specified Product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner. All sizes, dimensions, locations for connections to other items as designed, clearances from building structure and other equipment have been verified.
4. Will remove substitution and pay all costs if differences discovered later that were not identified on the substitution request are found that make the substitution unacceptable with no additional cost to Owner.
5. Waive claims for additional costs or time extension that may subsequently become apparent.
6. Will reimburse Owner and Architect/Engineer for review or redesign services associated with substitution.
7. They are authorized to sign this form for the product manufacturer, and commit to the terms of Section ASubstitutions and Product Options, @ and this substitution request form.

Submitted By: _____

Signed By: _____

Firm: _____

Address: _____

Telephone: _____ Fax: _____

A/E=s REVIEW AND ACTION

- Submission approved - Make submittals in accordance with Specification Section 013300.
- Submission approved as noted - Make submittals in accordance with Specification Section 013300.
- Submission rejected - Use specified materials.
- Submission request received too late - Use specified materials.

Signed by: _____ Date: _____

Supporting Data Attached:

- Drawings Product Data Samples Tests Reports
- Comparison list Other

SECTION 017300 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 - 2. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 3. Division 01 Section "Construction Waste Management and Disposal" for handling and processing construction debris.
 - 4. Division 01 Section "Closeout Procedures" for final cleaning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings.
- B. General:
1. Establish benchmarks and control points to set lines and levels of construction and elsewhere as needed to locate each element of Project.
 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

C. Building Lines and Levels: Locate and lay out lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Contractor shall provide as-built drawing information, indicating the locations of underground site improvements and utilities constructed on the site.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling, unless indicated otherwise.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
 - 1. No asbestos containing materials shall be used in the work.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.
- C. Construction Manager to show OS/01 items on the project work schedule.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work. It is the Contactor's responsibility for job site safety.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - a. Clean interior spaces prior to the start of finish painting, and continue cleaning on an as-needed basis until painting is finished.
 - b. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.
 3. Remove materials and debris that create tripping hazards.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove dirt, debris and garbage from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.8 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

3.11 OWNER-SUPPLIED PRODUCTS

- A. Contractor shall move owner-supplied products for installation according to documents.
 - 1. The contractor is responsible for all required mechanical and electrical final hook-ups to owner-supplied products.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
 - 1. For correction of installed work.
 - 2. For repairs due to testing.
- B. Related Sections include the following:
 - 1. Division 02 Section "Selective Structure Demolition and Alterations" for demolition of selected portions of the building and additional patching requirements.
 - 2. Divisions 02 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place 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.

1.4 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. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 2. 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.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:

1. Primary operational systems and equipment.
 2. Air or smoke barriers.
 3. Fire-suppression systems.
 4. Mechanical systems piping and ducts.
 5. Control systems.
 6. Communication systems.
 7. Conveying systems.
 8. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Equipment supports.
 4. Piping, ductwork, vessels, and equipment.
 5. Noise- and vibration-control elements and systems.
- D. 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.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- 1.6 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 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 in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 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 in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable earthwork Division Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.

- C. 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.
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 retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.
 - 2. Division 02 Section "Selective Structure Demolition and Alterations" for disposition of special waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each party involved.
2. Review and finalize procedures for materials separation and verify availability of containers and bins needed.
3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
4. Review waste management requirements for each trade.

1.5 WASTE MANAGEMENT PLAN

- A. General: Develop plan consisting of waste identification and waste reduction work plan for demolition and construction waste.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 1. Distribute waste management plan to everyone concerned.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Sale and Donation: Not permitted on Project site.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE

- A. General: Recycle paper and beverage containers used by on-site workers.

- B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 - 2. Division 01 Section "Execution Requirements" for progress cleaning of Project site.
 - 3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
 - 6. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Prepare and submit Project Record Documents, operation and maintenance manuals
 - 5. , and similar final record information. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 6. Coordinate final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

7. Complete startup testing of systems.
8. Submit test/adjust/balance records.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Advise Owner of changeover in heat and other utilities.
11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
12. Complete final cleaning requirements, including touchup painting.
13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
- C. Certificate of Completion: When the Architect determines the project has reached final completion, Architect will prepare MSHA form "Certificate of Completion of Design Professional."

1.5 INSPECTION FEES

- A. If the Architect Performs Reinspections Due to Failure of the Work to Comply with the Claims of Status of Completion Made by the Contractor, Or, Should the Contractor fail to complete the work, Or, Should the Contractor fail to promptly correct warranty items or work later found to be deficient:
 - 1. Owner will compensate Architect for such additional services.
 - 2. Owner will deduct the amount of such compensation from the final payment to the Contractor.
- B. If the Work is not completed by the date set in the Agreement, and the Architect needs to perform additional Contract Administrative and on site observation duties:
 - 1. Owner will compensate Architect for such additional services.
 - 2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Contractor shall submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.7 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated in the contract documents.
 - 1. Unless indicated otherwise, all warranties shall commence on the date of Substantial Completion.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Submit final warranties as a package for the entire project, assembled and identified as described below.
 - 2. Bind warranties and bonds in heavy-duty, D-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents but not greater than 2 inches, and sized to receive 8-1/2-by-11-inch paper. Do not over fill D-ring, allowing 1/2-inch space for future additions.
 - 3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 5. Electronic Media: Submit copy of warranty binder on CD-R in .PDF format. Bookmark based on the table of contents, and for each warranty within each section.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations for areas disturbed and dirtied by demolition and for new construction operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Remove snow and ice to provide safe access to building.
- f. Clean exposed exterior and interior hard-surfaced finishes, including walls, floors and ceilings, to a dirt-free/dust-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- g. Clean interior and exterior of cabinets, wiping surfaces to remove all dust and dirt..
- h. Remove debris and surface dust created by the work from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- i. Sweep concrete floors broom clean in unoccupied spaces.
- j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
Resilient flooring shall be scrubbed and cleaned with specialty floor cleaner recommended by the flooring manufacturer just prior to occupation by Owner.No-wax floors shall buffed in accordance with flooring manufacturer's requirements.
- k. New floors to receive a sealer shall be sealed just prior to occupation by Owner. Sealer shall consist of two coats, properly buffed to a uniform sheen. Work shall be done by a floor care subcontractor. Coordinate selection of sealer with flooring manufacturer and Owner's maintenance program. Flooring R1 shall be sealed.
- l. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- m. Remove labels that are not permanent.
- n. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
- o. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- p. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- q. Replace parts subject to unusual operating conditions.
- r. Replace disposable air filters exposed to demolition and construction activities and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- s. Clean ducts, blowers, and coils if units were operated without filters during construction.
- t. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
- u. Leave Project clean and ready for occupancy.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Operation manuals for systems, subsystems, and equipment.
 - 3. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
 - 4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

- A. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments after final inspection.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name, address, and telephone number of Contractor and primary subcontractors.
 - 6. Name and address of Architect.
 - 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
 2. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.

7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard printed maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and

conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Record Shop Drawings.
- B. Related Sections include the following:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Submit one set(s) of marked-up Record Prints, and one copy on CD-R in .PDF format.
 - 1) Electronic Media: CD-R.
- B. Record Specifications: Submit one hard copy and one copy on electronic media of Project's Specifications, including addenda and contract modifications.
- C. Record Shop Drawings and Product Data: Submit one hard copy of each Product Data submittal.
 - 1. Where Record Shop Drawings and Product Data is required as part of operation and maintenance manuals, submit marked-up Shop Drawings and Product Data as an insert in manual instead of submittal as Record Shop Drawings and Product Data. Insert typewritten pages indicating drawing titles, descriptions of contents, and Record Shop Drawings and Product Data locations drawing locations that are part of operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
 6. Electronic Media: Submit record copy of record specification on CD-R in .PDF format. Bookmark based on the table of contents.

2.3 RECORD SHOP DRAWINGS AND PRODUCT DATA

- A. Preparation: Mark Shop Drawings and Product Data, including equipment operation manuals to indicate the actual product installation where installation varies substantially from that indicated in Shop Drawings and Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
 4. Bind product data in heavy-duty, D-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents but not greater than 2 inches, and sized to receive 8-1/2-by-11-inch paper. Do not over fill D-ring, allowing 1/2 inch space for future additions.
 5. Provide heavy paper dividers with plastic-covered tabs for each specification section with product data. Mark tab to identify the specification section. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 6. Identify each binder on the front and spine with the typed or printed title "PRODUCT DATA," Project name, and name of Contractor.
 7. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. Maximum size of drawings to be included in the binders shall not exceed 11-by-17-inch. Fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and submit envelopes with manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for requirements for pre-instruction conferences.
 - 2. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

- A. At completion of training, submit one complete training/instruction/operation manual(s) for Owner's use.

1.4 QUALITY ASSURANCE

- A. Demonstrator and Trainer Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate providing notification of dates, times, length of instruction time, and training content.
- C. Coordinate content of training with content of approved operation and maintenance manuals.
- D. General Contractor shall schedule a meeting with the flooring contractor, flooring product representative and Maine Veterans' Homes facilities department to provide Maine Veterans' Homes with training on the maintenance of the new flooring products.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program: Develop an instruction program that includes individual training for each system and equipment not part of a system, as required by individual Specification Sections, and including the following:
1. HVAC systems, including instrumentation and controls.
 2. Electrical service and distribution, including switchboards, and panelboards.
 3. Lighting equipment and controls.
 4. Pool equipment and systems.
- B. Training: Include instruction as applicable for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 2. Documentation: Review the following items in detail:
 - a. Operations and maintenance manuals.
 - b. Project Record Documents.
 - c. Warranties and bonds.
 - d. Maintenance service agreements and similar continuing commitments.
 - e. Applicable video presentations.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Startup procedures.
 - c. Equipment or system break-in procedures.
 - d. Routine and normal operating instructions.
 - e. Regulation and control procedures.
 - f. Control sequences.
 - g. Safety procedures.
 - h. Instructions on stopping.
 - i. Normal and emergency shutdown instructions.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.

5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance
 - f. Procedures for routine maintenance
 - g. Instruction on use of special tools
8. Repairs: Include the following:
 - a. Diagnosis instruction
 - b. Repair instructions
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble materials necessary for instruction.

3.2 DEMONSTRATION AND TRAINING INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide demonstration and training instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner with at least fourteen days' advance notice.

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION AND ALTERATIONS

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.

1.02 SUMMARY

- A. This section includes the following:
 - 1. Demolition and removal of selected site elements.
 - 2. Repair procedures for selective demolition operations.
- B. Related sections including the following:
 - 1. Division 1 Section "Construction Progress Documentation" for pre-construction photographs taken before selective demolition.
 - 2. Division 1 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selection demolition operations.
 - 3. Division 31, 32 and 33 – Refer to site civil drawings for requirements regarding site work.

1.03 DEFINITIONS

- A. Remove: Detach items from existing site construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and re-installed.
- B. Removal and Reinstall: Detach items from existing site construction, prepare them for reuse, and reinstall them where indicated.

1.04 MATERIAL OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site. Materials in the public way shall be removed as directed by governing agencies.

1.05 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

- D. Schedule of Selective Demolition Activities. Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shut-off, capping, and continuation of utility services.
 4. Locations of proposed dust-and noise-control temporary partitions and means of egress.
 4. Means of protection for items to remain and items in the path of waste removal from building site.
- F. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by construction operations. Submit before Work begins.

1.06 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this project.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design and extent.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241and UFAS.
- E. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review shoring sequencing during removal of existing site materials and existing structural components.
 3. Review methods of protecting off site surfaces/utilities during selective demolition.
 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
 5. Provide 72-hour minimum advance notice to participants prior to convening pre-demolition conference.
 6. Review equipment/appliances supplied by owner to contractor for final installation.

1.07 PROJECT CONDITIONS

- A. Maintain access to existing walkways, and other adjacent occupied or used facilities.
1. Do not close or obstruct walkways, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.

- B. Owner assumes no responsibility for condition of areas to be selectively demolished.
- C. Notify Architect in writing of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
- E. Storage of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing overhead utilities indicated and protect them against damage during selective demolition operations and building construction.

PART 2 - PRODUCTS

2.01 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use a material whose installed performance equals or surpasses that of existing materials.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing site conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged. Refer to site civil documents.
- D. Engage a professional engineer to survey condition of adjacent buildings to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
 - 1. Engineer shall develop shoring and underpinning plans and procedures for removal of site components indicated to be removed.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective site demolition activities.

3.02 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during

selective demolition operations.

- B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. Where utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 2. Cut off pipe or conduit to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

- C. Utility Requirements: Refer to Division 20 and 26 Sections for shutting off, disconnecting, removing and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing. Retain connectivity to existing work stations adjacent to demolition areas.

3.03 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities outside limits of Work, as defined on Drawings, without permission from Owner and authorities having jurisdiction. Provide alternative routes around closed or obstructed traffic ways if required by Owner or governing regulations.
 - 2. Erect construction fence with entry gates; coordinate location with Architect and Owner.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.

- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

- C. Temporary Ventilation: Provision shall be made during construction to ventilate the work by mechanical ventilation.
 - 1. The permanent ventilation system shall be fully operational and run full time for a minimum of 2 weeks before date established for Substantial Completion. Cost of operation shall be included as part of the work.

- D. Temporary Shoring: Provide and maintain exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain; and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.04 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 - 1. Do not use water when it may damage existing construction or create hazardous or

objectionable conditions, such as ice, flooding, and pollution.

- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations begin.

3.05 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing materials only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective site demolition systematically
 - 2. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 3. Break up and remove concrete slabs on grade and foundations as required.
 - 4. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items: Comply with the following:
 - 1. Clean salvaged items. (Existing brick pavers, granite)
 - 2. Pack or crate items after cleaning.
 - 3. Store items in a secure area until reinstallation.
- C. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power driven saw, then remove concrete between saw cuts.

3.07 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section "Cutting and Patching."

3.08 DISPOSAL OF DEMOLISHED MATERIALS

- A. Burning: Do not burn demolished materials.
- B. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.09 CLEANING

- A. Clean all areas on completion of selective demolition operation. Refer to drawings

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes, and underslab vapor barrier system.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earthwork" for drainage fill under slabs-on-grade.
 - 2. Division 31 Section "Cement Concrete Pavement" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117 - Specifications for Tolerances for Concrete Construction and Materials
 - 2. 301 - Specifications for Structural Concrete for Buildings
 - 3. 305R - Hot Weather Concreting
 - 4. 306R - Cold Weather Concreting
 - 5. 309R - Guide for Consolidation of Concrete
 - 6. 315 - Manual of Standard Practice for Detailing Reinforced Concrete
 - 7. 347 - Recommended Practice for Concrete Formwork
 - 8. 318 - Building Code Requirements for Reinforced Concrete
 - 9. 544.1R - State-of-the-Art Report of Fiber Reinforced Concrete
 - 10. 554.2R - Measurement of Properties of Fiber Reinforced Concrete
- B. American Society for Testing and Materials (ASTM):
 - 1. A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 2. C 33 - Concrete Aggregate
 - 3. C 39 - Compressive Strength of Cylindrical Concrete Specimens

4. C 94 - Ready-Mixed Cement
5. C 150 - Portland Cement
6. C 260 - Air-Entraining Admixtures for Concrete
7. C 309 - Liquid Membrane-Forming Compounds for Curing Concrete
8. C 494 - Chemical Admixtures for Concrete
9. C 1018 - Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading)
10. C 1116 - Type III, Sections 4.1.3 and 4.2, and Performance Level I, Toughness Index I5 outlined in Section 21, Note 17, Standard Specification for Fiber-Reinforced Concrete and Shotcrete

C. Federal Specifications (FS):

1. TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI - Manual of Standard Practice and Recommended Practice for Placing Reinforcing Bars (MSP-latest edition)

E. American Welding Society (AWS)

F. Scaffolding and Shoring Institute (SSI):

1. Scaffolding and Shoring Safety Rules

1.5 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 1. Provide cement manufacturer's letter of certification and chemical content test results stating that the Portland cement is in compliance with ASTM designation C 150.
 2. Indicate amounts of mix water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Flatwork Certificates: Copies of supervisors "ACI Concrete Flatwork Technician" certificate.

- F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
1. Cementitious materials and aggregates.
 2. Form materials and form-release agents.
 3. Steel reinforcement and reinforcement accessories.
 4. Fiber reinforcement.
 5. Admixtures.
 6. Curing materials.
 7. Bonding agents.
 8. Adhesives.
 9. Waterstops.
 10. Vapor retarders.
 11. Epoxy joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
1. Flatwork (interior and exterior slabs) shall be placed, finished and cured under the direct supervision of a "Certified ACI Concrete Flatwork Technician".
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An independent testing agency, approved by the Engineer and acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

- F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor and Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixes.
 - c. Ready-mix concrete producer.
 - d. Concrete subcontractors.
 - e. Architect.
 - f. Owner's representative.
 2. Flatwork (interior and exterior slabs) Preinstallation Conference: Conduct conference at Project site to review all details and requirements for the batching, mixing, transporting, placing, finishing, and curing all interior and exterior flatwork operations. Require representatives of each entity directly concerned with flatwork operation to attend, including the following:
 - a. Contractor and Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixes.
 - c. Ready-mix concrete producer.
 - d. Flatwork subcontractors.
 - e. Cement Manufacturer's factory representative
 - f. Architect.
 - g. Owner's representative.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.8 PROJECT CONDITIONS

- A. To prevent exterior concrete entrance slabs, pavement and walls from repeated freeze thaw cycles and deicers before adequate curing to protect concrete has occurred, placement shall meet the requirements of ACI 306R, Cold Weather Concreting. No deicers shall be used on the concrete during the project.
- B. Apply surface evaporation retardant to slab surface when water loss reaches .15 lbs of water loss per square foot (.6kg per sm) per hour as determined in ACI 308.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Structural 1, B-B, or better, mill oiled and edge sealed.
 - 2. Manufactured forming system: metal or other panel system with prior review and approval.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
 - 1. Bars shall be clean and free from rust, scale or coatings that will reduce bond. Reinforcing steel shall be capable of bending 180 degrees and rebending to original shape without fracture.
- B. Plain-Steel Wire: ASTM A 82, galvanized.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II.
 - 1. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 120.
 - a. At the contractor's option, slag cement may be blended with type II cement to modify specific properties of the concrete. The percentage of slag cement recommended by the supplier shall be approved by the Engineer.
 - b. At the supplier's option, slag cement may be blended with type II cement to achieve the performance of 0.60% alkali. The cement supplier shall provide a letter certifying the percentage of slag cement required to achieve the performance of low alkali cement specified.
 - c. Ground Granulated Blast-Furnace Slag **NOT ALLOWED** in one-way structural slab-on-grade mix designs
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Class: Severe weathering region, but not less than 3S.
 - 2. Nominal Maximum Aggregate Size: 3/4 inch.
- C. Lightweight Aggregate: ASTM C 330, 3/8-inch nominal maximum aggregate size.
- D. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- G. Non-Corrosive Accelerator: ASTM C 494, Type C or E.
 - 1. Non –corrosive accelerator shall have long-term test data proving its non-corrosive effect on reinforcing steel.
- H. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Catexol 1000CL; Axim Concrete Technologies.
 - b. MCI 2000 or MCI 2005; Cortec Corporation.
 - c. DCI or DCI-S; W. R. Grace & Co., Construction Products Div.
 - d. Rheocrete 222+; Master Builders, Inc.
 - e. FerroGard-901; Sika Corporation.

2.6 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Fibrillated Fibers:
 - a. Fibrasol F; Axim Concrete Technologies.
 - b. Fibermesh; Fibermesh, Div. of Synthetic Industries.
 - c. Forta; Forta Corporation.
 - d. Grace Fibers; W. R. Grace & Co., Construction Products Div.
 - 2. Monofilament Fibers:
 - a. Fibrasol IIP; Axim Concrete Technologies.
 - b. Fiberstrand 100; Euclid Chemical Co.
 - c. Fibermix Stealth; Fibermesh, Div. of Synthetic Industries.
 - d. Forta Mono; Forta Corporation.
 - e. Grace MicroFiber; W. R. Grace & Co., Construction Products Div.
 - f. Hi-Tech PPM Fiber; Hi-Tech Fibers, Div. of Martin Color-Fi, Inc.
 - g. Polystrand 1000; Metalcrete Industries.

2.7 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete. Parastop II by Paramount Technical Products, Inc. or approved equal.

2.8 VAPOR RETARDER SYSTEM (UNDER FLOOR SLABS).

- A. Vapor Retarders: Provide water-resistant barrier consisting of high density, polyethylene meeting the following specifications:
 - 1. Permeance Rating: ASTM E 96, 0.036 Perms or lower.
 - 2. Puncture Resistance: ASTM E 1745, minimum 2340 grams.
 - 3. Tensile Strength: ASTM E 1745, minimum 54.4 lbf./in.
 - 4. Meets to ASTM E 1745, Class A and B standards for underslab vapor retarders.
- B. Product: Subject to compliance with requirements, provide Stego Wrap by Stego Industries, LLC, 10 mil thick vapor retarder. (877) 464-7834.
- C. Seam Tape: Seam Tape must have the following qualities:
 - 1. Water Vapor Transmission Rate; ASTM E 96, 0.3 perms or lower
 - 2. Stego Tape by STEGO INDUSTRIES LLC, San Juan Capistrano, CA (877) 464-7834, www.stegoindustries.com
- D. Mastic: Mastic must have the following qualities:
 - 1. Water Vapor Transmission Rate; ASTM E 96, 0.3 perms or lower
 - 2. Stego Mastic by STEGO INDUSTRIES LLC, San Juan Capistrano, CA (877) 464-7834, www.stegoindustries.com
- E. Pipe Boots
 - 1. Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

2.9 EXTERIOR ON-GRADE SLAB TREATMENTS

- A. Water Repellent and Chloride Screen: Equal to Consolideck Saltguard by ProSoCo, Inc. Consolideck Saltguard.

2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Clean and Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- F. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Evaporation Retarder:
 - a. Sure Film; Dayton Superior Corporation.
 - b. Eucobar; Euclid Chemical Co.
 - c. Confilm; Master Builders, Inc.
 - d. SikaFilm; Sika Corporation.
 - 2. Clear, Waterborne, Membrane-Forming Curing Compound:
 - a. AH Clear Cure WB; Anti-Hydro International, Inc.
 - b. Safe Cure and Seal; Dayton Superior Corporation.
 - c. Aqua Cure VOX; Euclid Chemical Co.
 - d. Vocomp-20; W. R. Meadows, Inc.
 - e. Kure-N-Seal WB; Sonneborn, Div. of ChemRex, Inc.

2.11 RELATED MATERIALS

- A. Isolation Joint Former (Columns): Provide as noted on Drawings one of the following:
 - 1. 4" x 24" diameter as manufactured by Greenstreak, P.O. Box 7139, St. Louis, MO 63177, or approved equal.
 - 2. 4" x 24" square diamond shaped as manufactured by Greenstreak, P.O. Box 7139, St. Louis, MO 63177, or approved equal.
- B. Perimeter Isolation Joint: 2 lb. density, cross linked polyethylene with removable strip-off equal to ISO-STRIP as manufactured for Century Floors, Topsham, Maine.
- C. Edge Tape: Vaporlock edge tape, pre-formed 3 inch wide two-sided adhesive.
- D. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- E. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- F. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- G. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.
- H. Doweling Adhesive: A two-component, vinylester blend resin equal to HI HY150 adhesive as manufactured by Hilti Fastening Systems, Tulsa, Oklahoma or approved equal
- I. Key Joint (Construction Joint only): 24 gauge galvanized steel with 1-1/8" dowel knockouts 6" on center. Keyway shall be equal to "Key-Lock Joint" with removable plastic cap strip by Form-A-Key Products Div., Louisville, KY 40214, or approved equal.
- J. Dowels: 24 (608 mm) inch long square dowels with sawn ends (sheared bars not acceptable).
 - 1. Dowel Sleeve: 3/4 inch (19 mm) by 12 (304 mm) inch long, plastic sleeve with 3/16 inch (4 mm) thick polyethylene foam on vertical legs equal to Expando-Lok by Jay Kay Sales.
 - 2. Dowel Aligner: Cast plastic dowel aligner with nailing flange.
- K. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- L. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- M. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water-reducing and plasticizing agents capable of minimum compression strength of 2,400 lbs. Non-shrink grout shall be equal to "Eucon N-S" (non-metallic) by the Euclid Chemical Co., "Masterflow 713" (non-metallic) by Master Builders, or Five Star Grout by U.S. Grout Corp.

2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Foundation Grade Beams, Walls and Pile Caps: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4,000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.49.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 5. Rebar/Mesh: As Noted on the drawings and/or structural notes.
- D. Interior One-Way Structural Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4,000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.47.
 1. Slump Limit: 4 inches, plus or minus 1 inch.
 2. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
 3. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.
 4. Rebar/Mesh: As Noted on the drawings and/or structural notes.
- E. Elevated Slabs on Metal Decking: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.49.
 3. Slump Limit: 4 inches, plus or minus 2 inch.
 4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
 5. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.
 6. Reinforcement: Provide 6 x 6 x W2.1 x W2.1 WWM on bolsters mid-depth between top of deck flute and slab surface.
- F. Miscellaneous Site Concrete not specified in other sections: Unless otherwise indicated, proportion normal-weight concrete mix as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: Shall not exceed 3 inches.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 5. Reinforcement: Noted in Structural Foundation Notes on Drawings.
- G. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.
- H. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete required to have low water permeability.
- I. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.
- J. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
1. Air Content: 6 percent for 3/4-inch-nominal maximum aggregate size.
- K. Do not air entrain concrete to trowel-finished interior floors. Do not allow entrapped air content to exceed 3 percent.
- L. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- M. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use corrosion-inhibiting admixture in concrete mixes where indicated.

2.14 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
1. When air temperature is between 85 and 90°F (30 and 32°C), reduce mixing and delivery time from one and one-half (1-1/2) hours to seventy-five (75) minutes; when air temperature is above 90°F (32°C), reduce mixing and delivery time to sixty (60) minutes.
- B. Concrete Moisture Vapor Reduction Admixture (MVRA): Concrete moisture vapor reduction admixture for all interior slab (on ground and elevated) and structural roof deck construction shall be a non-toxic, liquid admixture that is specifically designed to have a natural chemical

reaction with pre-existing elements inside the concrete to eliminate the route of moisture vapor emission through the slab by restricting the integral capillary system. The chemical reaction forms a permanent barrier (capillary break) that is integral to the concrete, insoluble and irremovable.

1. Basis-of-Design Product: **“Barrier One High Performance Concrete Admixture”** manufactured by Barrier One, Inc.; 522 S. Hunt Club Blvd., #303, Apopka, Florida 32703; Contact Manufacturer’s representative: P: 877.224.5850, F: 866.594.3490 or Email at: info@barrierone.com .
2. Provide the above named product or, upon approval of the Architect/Structural Engineer, provide a product that meets or exceeds the below project specific performance requirements at the expense of the concrete moisture vapor reduction admixture (MVRA) manufacturer:
 - a. Project specific quality control process to include but not limited to:
 - 1) Independent procurement of one cylinder per day of placement of concrete containing MVRA; do not proceed without MVRA representative being present
 - 2) Independent testing of all cylinders for hydraulic conductivity per ASTM D5084
 - 3) Assessing each cylinder for maximum flow of 6.0 E-08 cm/sec
 - 4) Should any cylinder exceed the maximum flow, procure a core from that day’s placement
 - 5) Independently test core for hydraulic conductivity per ASTM D5084
 - 6) Should any core exceed the maximum flow, provide a topical moisture mitigation system for all areas not meeting the stated limit; moisture mitigation system to include all labor, material and warranty that meets or exceeds the terms of the concrete moisture vapor reduction admixture manufacturer’s warranty
 - b. Warranty requirements: Said product must be installed according to and in compliance with the manufacturer’s published data sheet to include but not limited to dosing instructions, onsite representation requirements, and the use of an ASTM E 1745 vapor retarder, installed following ASTM E 1643 and ASTM F 710 guidelines; suspended concrete slabs do not require a vapor retarder.
 - 1) MVRA Manufacturer’s warranty shall include:
 - a) Term: Life of the concrete
 - b) Repair and/or removal of failed flooring
 - c) Placement of a topical moisture remediation system
 - d) Replacement of flooring materials like original installed to include material and labor
 - 2) MVRA Manufacturer shall provide an adhesion warranty to match the term of the adhesive manufacturer’s warranty in accordance with the MVRA manufacturer’s requirements for conveyance of such.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
 - 1. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Excessive deflection of forms after concrete is poured shall be sufficient cause for rejection of that portion of concrete and formwork. Excessive deflection will be considered to be that which will produce visible and noticeable waves in the finished concrete.
 - 2. Construct forms so that walls will key into each other at ends unless poured monolithically.
- B. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Surfaces exposed to view: Class A, 1/8 inch
 - 2. Surfaces not exposed Class C, 1/2 inch
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. All possible care shall be taken in the formwork to produce surfaces free from honeycomb or other defects.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Schedule the work and notify other trades in time so that provisions for their work in the formwork can be made without delaying progress of the project. Verify that all sleeves, pipes, etc., for electrical, plumbing, heating and ventilation, or other work are installed.
- I. Chamfer exterior corners and edges of permanently exposed concrete.

- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- L. Bolts, rods or other approved devices shall be used for internal ties. They shall be so arranged that when the forms are removed, no metal shall be within 1" of any surface.
- M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Secure information about and provide for all openings, offsets, recessed nailing blocks, channel chases, anchors, ties, inserts, etc., in the formwork before concrete is poured.
 - 2. Install anchor bolts, accurately located, to elevations required.
 - a. The setting of all anchor bolts and the grouting for all structural steel base plates shall be included as part of this contract. Bolts and base plates will be furnished under Section 05500 - Metal Fabrications.
 - b. All column base plates, equipment bases, and other locations noted in the structural drawings shall be grouted with the specified non-shrink grout. All exposed grout shall be the specified non-metallic type.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 MOISTURE VAPOR RETARDER SYSTEM (UNDER FLOOR SLABS)

- A. Moisture vapor retarder system shall be installed at all interior floor slabs and as otherwise indicated in the drawings in strict accordance with the manufacturer's printed instructions and as follows.
 1. Snap chalk line along inside perimeter of foundation walls at top of slab elevation.
 2. Without wetting, clean a 3" wide band on the surface of the concrete below the chalk line at approximately mid-slab height. Remove dirt, residual form release, or other bond inhibiting surface contaminants. Grind smooth any surface projections within the band.
 3. While removing the contact paper on the backside, firmly press 2" wide perimeter and penetration strip onto wall, parallel to the chalk line on the cleaned band at mid-slab elevation.
 4. Remove contact paper on the face side.
 5. Apply 12" wide edge roll covering only the bottom 1" of contact surface on the perimeter strip. Cut, fit, and seal corner details with seaming tape.
 6. Align top edge of isolation joint material to chalk line, and press material onto remaining 1" of exposed perimeter strip adhesive.
 7. Roll out Vapor barrier material, overlapping edge rolls and all seams by 3". Tape all seams with seaming tape.
 8. All tears, punctures, etc. to be repaired and taped as required to maintain the watertight integrity of the vapor barrier system.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Steel reinforcing shall not be bent in a manner that will injure the material or the embedding concrete. Bars with kinks or bends not shown on the plans shall not be used. Heating of reinforcement for bending will not be permitted. Bars shall be bent once only (no rebending or straightening allowed) unless shown as such on the drawings.
 2. All details of reinforcement not shown or indicated on the drawings or specifically called for in the specifications shall conform to ACI 315.
 3. Lap all bars at splices, corners and intersections a minimum of 36 bar diameters unless otherwise indicated. Laps of welded-wire fabric shall be at least two times the spacing of the members in the direction lapped but not less than twelve inches.
 4. All intersecting concrete walls shall be tied with #4L bars 3'-0" long, bent 18" x 18" spaced 12" on center, outside face only unless otherwise indicated.
 5. Splices of reinforcement shall not be made at points of maximum stress. Splice lengths shall be a minimum of 36 bar diameters unless otherwise indicated and shall provide sufficient lap to transfer the stress between bars by bond and shear. Stagger splices of adjacent bars where possible. All splices and laps at corners and intersections shall be tied with wire at each end.

6. Where obstructions (pipes, conduit, ducts, etc.) prevent the intended placement of reinforcing, provide additional reinforcing as directed by the Engineer or his Representative around the obstruction to match that reinforcing interrupted.
 7. Provide additional stirrups, ties, trim bars, etc., as directed around all openings, sleeves, pipes, and conduits, which pass through structural elements.
 8. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Coverage of bars (including stirrups and column ties) shall, unless otherwise shown, be as follows:
 - a. Footings: 3" soil face, 2" top
 - b. Slabs (on grade): 2" soil face, 1-1/2" top face
 - c. Walls: 2" clear to form at exterior
 2. Misplaced Reinforcing: If any reinforcing bars are found to be misplaced after concrete has been placed, the Engineer shall be notified immediately and no correction or cutting shall be made without his direction. Misplaced bars shall not be bent or kinked. Any redesign and/or reinforcing required because of misplaced bars shall be at the Contractor's expense.
 3. All reinforcing shall be kept separate from soil, pipe, conduit ducts, etc., by approved non-metallic separators.
 4. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- C. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - a. Wall control "V" joints shall have a depth of 1/8 times the thickness of the wall and be 1/2" wide at surface. "V" joints shall be placed as shown or as directed by the Engineer.

4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, or 3/4" minimum for soft-cut as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/4" maximum wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - a. Floor slab control joints shall be placed as shown on the foundation plan. Unless otherwise noted, control joints shall be spaced at intervals not to exceed 12'-0" on center in both directions.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. All intersecting slab construction joints acting as control joints shall be doweled according to the following schedule unless otherwise indicated. Dowels shall be smooth, steel grade 60 with saw cut ends. Grease, wrap or cap one end.

Dowel Schedule

	Dowel Dia.	Length	Spacing
4" Slab	1/2"	12"	12"
5" Slab	5/8"	14"	12"
6" Slab	3/4"	14"	12"
7" Slab	7/8"	14"	12"
8" Slab	1"	14"	12"

3.7 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.
1. Remove all protrusions and indentations 2" or over in all areas.
 2. Lay waterstop flat against concrete surface and nail every 1" to 6" with case hardened washered nails.
 3. Overlap all joints a minimum of 2".

3.8 MIXING CONCRETE

- A. General: The concrete shall be mixed in the quantities required for immediate use, and any which has developed initial set or exceed the time limit of ASTM C 94 shall not be used. No retempering of mortar or concrete shall be allowed under any circumstances. Concrete shall be proportioned, mixed and placed only in the presence of the Engineer or his Authorized Representative. The Contractor shall give ample notice to the Engineer before mixing is commenced. Aggregate size will be adjusted to suit conditions of work. Pumping of concrete shall be permitted only after approval by the Engineer of the Pumping Contractor and the pumping equipment and method to be employed. The Engineer shall be notified of dates when pumping of concrete shall be performed to permit his on-the-job inspection of the operations.
- B. Final proportions shall be in accordance with approved mix designs. Adjustments to approved proportions, for whatever reason, shall be approved by the Engineer.
- C. Add fibrous concrete reinforcing to all concrete used at slabs on grade (interior and exterior), sidewalks and exterior stairs. The amount of fiber reinforcement shall be in accordance with the manufacturer's recommendations and approved submittals. Add the fibrous reinforcement at the time the concrete is batched; mix in strict accordance with the manufacturer's instructions and recommendations for a uniform and complete distribution.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Remove loose dirt, mud, standing water, and foreign matter from excavations or from cavities.
- C. Thoroughly clean reinforcement and other embedded items free from loose rust and other matter. Assure reinforcing is held securely in place.
- D. Thoroughly wet wood forms (except coated plywood), bottom and sides of trenches, base underslab, and adjacent concrete or masonry at least one hour in advance of placing concrete; securely close cleanout and inspection ports; repeat wetting as necessary to keep forms damp.
- E. Equipment shall be maintained clean and of sufficient quantity and capacity to efficiently execute the work required.

- F. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- G. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- H. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
 - a. concrete shall be vibrated into final position in forms with an internal type vibrating machine. The vibration shall have a frequency of not less than 8,000 vibrations per minute. The mechanical vibrating equipment shall be satisfactory to the Engineer.
 - b. The vibration shall be of sufficient intensity and duration to cause flow or settlement of the concrete and complete consolidation. Over vibration, especially of mixtures that are too wet, may cause segregation and will be avoided. A sufficient number of vibrators shall be provided to permit consolidation of each batch before the next batch is delivered and without delaying the delivery.
 - c. The vibrations shall be applied directly to the concrete, and vibration through the forms shall not be permitted. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The concrete shall be placed in layers of uniform thickness
 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
 3. When conditions make puddling difficult, or where the reinforcement is congested, batches of mortar containing the same proportions of cement to sand used in the concrete shall be deposited in the forms. The operation of filling with the regularly specified mix shall be carried on at such a rate that the mix is at all times plastic and flows readily into the spaces between the bars.
 4. In thin walls or inaccessible portions of the forms where rodding is impractical, the concrete shall be worked into place by tapping or hammering forms adjacent to the freshly deposited concrete.
 5. The Contractor's attention is called to the importance of making the concrete dense, and he shall provide sufficient labor to the entire satisfaction of the Engineer to thoroughly consolidate the concrete, avoid air pockets and voids in exposed sections, and leave smooth, uniform surfaces after forms are removed.
 6. Should any honeycombed concrete be disclosed upon removal of forms, the Contractor shall immediately cut out the said honeycombed portions back to solid concrete and shall

fill the opening thus formed with a concrete of the same proportions as that specified for the section of work in which the fault occurs.

7. When placing fresh concrete upon hardened concrete, the latter shall be thoroughly roughened and cleaned of all loose material, scum or latency. The bonding compound shall be applied and the new concrete placed while the bonding compound is still tacky.
 8. Joints in the concrete work shall be made only in places and the manner specified by the Engineer.
 9. The Contractor's attention is called to the importance of properly and carefully placing concrete around reinforcement, as the reinforcing metal must not be exposed; and in cases where reinforcing metal becomes exposed on the surface, that portion of work must be removed and re-laid as the covering of same by plastering with cement mortar will not be allowed. All reinforcing rods or other reinforcing material shall be lightly tapped so that they will retain their original position.
 10. No concrete shall be retempered except as allowed in ASTM C 94 nor shall set concrete be used as aggregate.
- I. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 - a. Reinforcement, unless otherwise indicated, shall be placed one-half the thickness of the slab.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
 6. In addition to steel bar reinforcement, slabs shall be reinforced with fibrous concrete reinforcement which is to be added when the concrete is being batched in strict accordance with the manufacturer's recommendations.
 7. Slabs shall be monolithically placed with control joints. Sawed control joints will be located as indicated on the drawings and/or as directed by the Engineer. Floors shall be cleaned of objects before saw cutting begins. A true, continuous saw cut is what is expected as a finish result.
- J. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

4. Contractor shall have on the job, ready to install, adequate equipment for heating the materials and the freshly placed concrete and for enclosing the work in accordance with the requirements specified herein.

K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

L. Protection:

1. Concrete just placed shall be protected from rain in an approved manner until the concrete has set, or if a slab, the curing compound has dried.
2. Concrete, when placed in the forms, shall have a temperature of not less than 50 degrees F or more than 90 degrees F. Freshly placed concrete and the surrounding air shall be maintained at a temperature of 50 degrees F or greater for a period of seven days after placing. If high early strength concrete is used, the aforementioned time period may be reduced to three days. The methods of protection and curing shall be such as to prevent evaporation of moisture from the concrete and injury to the surface.
3. Should it later develop that any concrete work has become injured in any way by freezing or otherwise, the defective concrete shall be repaired or replaced as directed by the Engineer at no added expense to the Owner. Repair materials shall include all reinforcement grouts, dry pack, admixtures, epoxy and aggregates as may be necessary

M. Deicer Protection:

1. Apply deicer protection to all exterior slabs on grade, stairs, sidewalks, and related work 30 days after concrete placement in strict accordance with manufacturer's written recommendations.

3.10 PROTECTIVE COATING FOR STRUCTURAL STEEL

- A. All structural steel and columns and their bases which extend into or through concrete floors or walls shall be thoroughly brush painted with two coats of foundation coating as specified in Section 07150 - Dampproofing, and applied in accordance with the manufacturer's directions, neatly cut off one inch below finish floor.

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.
 - 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 - 2. Do not apply rubbed finish to smooth-formed finish.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.12 PREPARATION FOR CONCRETE MOISTURE VAPOR REDUCTION ADMIXTURE (MVRA)

- A. Prepare substrates according to manufacturer's written instructions to insure adhesion of flooring products
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 2. Slab Porosity and Adhesion Testing: Perform tests recommended by manufacturer, following each individual adhesive manufacturer's application instructions for use on non-porous substrates if applicable.
 - 3. Moisture Testing: As specified in Division 03 Section "Cast-In-Place Concrete". No further moisture testing shall be required prior to installation of the floor coverings.
 - 4. Alkalinity Testing: Not required prior to installation of the floor coverings.

3.13 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
 - 1. All interior concrete floor slabs shall be finished true and smooth by steel troweling or finishing machine. All exterior slabs, pads, ramps, stairs, and sidewalks shall be broom finished.

2. When a section of the concrete floor is completed, it shall be left entirely undisturbed until the concrete is thoroughly hardened.
 3. Adequate provisions will be made to eliminate the possibility of accidental encroachment upon the newly concreted area.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish.
- C. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
 2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
 - a. Tolerances will be in accordance with ACI Publication #117 - Class AX. Depression in floor between high spots shall not be greater than 3/16" in 10'-0" \pm 1/16", and the measurement will be taken by the straight edge method no later than the day after the concrete floor has been poured.
- D. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.14 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- D. Mechanical Equipment Pads: Provide 4" concrete pads reinforced with 6x6 - W1.4xW1.4 welded-wire fabric under all mechanical equipment supported on concrete floor slab unless otherwise indicated.
- E. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.
- F. Foundation Insulation: Install foundation insulation using a dab of emulsified asphalt mastic in each corner and the center to adhere the insulation to the concrete wall. Insulation will be installed on the inside face of all perimeter foundation walls extending from the underside of floor slab to top of footing. Insulation furnished under Section 07200 - Insulation.

3.15 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, and other surfaces as indicated below.
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 4. Waterproof Paper: Apply waterproof paper in accordance with manufacturer's recommendations in widths as wide as possible. Paper shall be lapped and seams taped with reinforced tape.
 - a. For Interior Non-Exposed Concrete: Typical curing operation for all interior slabs with moisture sensitive floor coverings. Verify individual requirements with flooring manufacture.
 5. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.16 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling till the completion of the project. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
- D. Install isolation joints around columns in accordance with the drawings and manufacturer's recommendations.
- E. Install perimeter isolation joints in accordance with the drawings and manufacturer's recommendations.

3.17 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inchwide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- D. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.18 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. Yd, but less than 25 cu. yd. plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 7. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi
- E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.

END OF SECTION 033000

SECTION 042000

BRICK, CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Brick unit masonry, modular sized water-struck brick.
2. Concrete masonry units- standard.
3. Thin brick unit, modular sized.

1.03 RELATED SECTIONS: The following sections contain requirements that relate to this Section:

A. Products installed but not furnished under this Section include the following:

1. Steel lintels in unit masonry are detailed on structural drawings.
2. Wood nailers and blocking built into unit masonry are specified in Division 6 Section "Rough Carpentry."
3. Hollow metal frames in unit masonry openings are specified in Division 8 Section "Steel Doors and Frames."
4. Aluminum Storefront in Division 084110
5. Glazed Aluminum Curtain Wall 089110

1.04 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following installed compressive strengths (f'm):

1. For brick masonry: As follows:
f'm = 2000 psi minimum.
2. For concrete masonry unit: As follows
fm = 1500 psi minimum.

1.05 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each different masonry unit, accessory, and other manufactured product indicated.

C. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.

D. Samples for verification purposes of the following:

1. Full-size units for each different exposed masonry unit required showing full range of exposed

color, texture, and dimensions to be expected in completed construction.

- E. Accessories embedded in the masonry.
- F. Cold-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

1.06 QUALITY ASSURANCE

- A. Preconstruction Tests by Unit Test Methods: Test the following materials by methods indicated:
 - 1. Brick Masonry Units: Test each type, class and grade of brick masonry units per ASTM C - 216 for grade SW Type FBS modular extruded brick.
 - 2. Mortar Tests: Test each mortar type per ASTM C 780.

1.07 SUBMITTALS

- A. General: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry off ground to prevent contamination by mud, dust, slats, or materials likely to cause staining or other defects.
- B. Cover materials as necessary to protect from the elements.
- C. Protect anchors, ties, and reinforcement from elements.

1.09 PROJECT CONDITIONS

- A. Protection of Work: During erection, cover top of walls with heavy waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.
 - Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.
- B. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed. Remove immediately grout or mortar in contact with such masonry. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
 - Protect sills, ledges and projections from droppings of mortar.
- C. Cold Weather Protection:
 - 1. Do not lay masonry units which are wet or frozen.
 - 2. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
 - 3. Remove all masonry determined to be damaged by freezing conditions.
 - 4. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10 deg F (6 deg C).

- a. 40 deg F (4 deg C) to 32 deg F (0 deg C):
Mortar: Heat mixing water to produce mortar temperature between 40 deg F (4 deg C) and 120 deg F (49 deg C).
Grout: Follow normal masonry procedures.
 - b. 32 deg F (0 deg C) to 25 deg F (-4 deg C):
Mortar: Heat mixing water and sand to produce mortar temperature between 40 deg F (4 deg C) and 120 deg F (49 deg C); maintain temperature of mortar on boards above freezing.
Grout: Heat grout materials to 90 deg F (32 deg C) to produce in-place grout temperature of 70 deg F (21 deg C) at end of work day.
 - c. 25 deg F (-4 deg C) to 20 deg F (-7 deg C):
Mortar: Heat mixing water and sand to produce mortar temperature between 40 deg F (4 deg C) and 120 deg F (49 deg C); maintain temperature of mortar on boards above freezing.
Grout: Heat grout materials to 90 deg F (32 deg C) to produce in-place grout temperature of 70 deg F (21 deg C) at end of work day.
Heat both sides of walls under construction using salamanders or other heat sources.
Use windbreaks or enclosures when wind is excess of 15 mph.
 - d. 20 deg F (-7 deg C) and below:
Mortar: Heat mixing water and sand to produce mortar temperature between 40 deg F (4 deg C) and 120 deg F (49 deg C).
Grout: Heat grout materials to 90 deg F (32 deg C) to produce in-place grout temperature of 70 deg F (21 deg C) at end of work day.
 - e. Masonry Units: Heat masonry units so that they are above 20 deg F (-7 deg C) at time of laying:
Provide enclosures and auxiliary heat to maintain an air temperature of at least 40 deg F (4 deg C) for 24 hours after laying units.
Do not heat water for mortar and grout to above 160 deg F (71 deg C).
5. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.
- a. 40 deg F (4 deg C) to 32 deg F (0 deg C):
Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
 - b. 32 deg F (0 deg C) to 20 deg F (-7 deg C):
Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
 - c. 20 deg F (-7 deg C) and below:
Except as otherwise indicated, maintain masonry temperature above 32 deg F (0 deg C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 deg F (4 deg C) for 48 hours.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

Manufacturer: Obtain masonry units from one manufacturer, of uniform texture and color for each kind required, for each continuous area and visually related areas.

Masonry Unit Characteristics: Provide units complying with standards referenced and requirements indicated. Masonry units selected and herein specified have been selected for size, texture, and color. Substitutions may be made if minimum requirements listed below are met and ARCHITECT approves substitution based on visual qualities and consistency.

A. Concrete Masonry Units (CMU):

1. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.
2. Size: A. Manufacturer's standard units with nominal face dimensions unless otherwise indicated.
3. Special Shapes: Provide where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions at coping.
4. Hollow Load-Bearing CMU: ASTM C 90; Grade N.
5. Weight Classification: Normal weight units unless otherwise indicated. (125 lbs. per cu. ft. or more, oven dry weight of concrete).
6. Cure units in a moisture-controlled atmosphere or in an autoclave at normal pressure and temperature to comply with ASTM C 90, Type I.
Limit moisture absorption during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest the project site.

B. Brick Masonry Units:

1. General: Comply with referenced standards and other requirements indicated below applicable to the brick masonry units required.
2. Sizes; Manufacturer's standard units - 2-1/4" x 3-5/8" x 7-5/8".
special shapes - Provide where required for lintels, corners, jambs, sills, sash, control joints, headers, bonding and all special conditions.
3. Brick Masonry: [REDACTED]
4. Efflorescence: Provide brick tested according to ASTM C67 and is rated non-efflorescence.

C. Thin Brick Masonry Units: Referred to T3 in Finish Legend

1. General: Comply with referenced standards and other requirements indicated applicable to the thin brick units required.
2. Sizes: Manufacturers standard units 2-1/4" x 5/8" x 7-5/8". Provide all special shapes required for a complete installation.
3. Thin Brick masonry: Boral Bricks "Queen Bricks"; www.boralbricks.com
4. Color to be selected from manufacturer's full line.

2.02 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, unless otherwise approved by Engineer. Provide full range of color options for architect's selection. Tinted mortar SGS 8SH Dark Chocolate

B. Masonry Cement: to be approved for this project.

- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.
- E. Aggregate for Grout: ASTM C 404.
- F. Water: Clean and potable.

2.03 WATER REPELLENT ADMIXTURE

- A. Concrete masonry units to contain water repellent admixture at time of manufacture.
- B. Mortar and grout to contain water repellent admixture.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - 1. Dryblock System, W.R. Grace or Adaiment Block Plus W-10.

2.04 MASONRY ACCESSORIES

- A. Drainage System: York Manufacturing flash vent 3 oz. NP System. Using great seal LT-100 liquid tape.
- B. Horizontal Joint Reinforcing and Ties for Masonry:
 - 1. Provide welded wire units prefabricated in straight lengths of not less than 10', with matching corner ("L") and intersecting ("T") units. Fabricate from cold-drawn steel wire complying with ASTM A 82, with deformed continuous side rods and plain cross rods, into units with widths of approximately 2" less than nominal width of walls and partitions as required to position side rods for full embedment in mortar with mortar coverage of not less than 5/8" on joint faces exposed to exterior and not less than 1/2" elsewhere. Provide the following type of joint reinforcing unless otherwise indicated:
 - a. Ladder type with perpendicular cross rods spaced not more than 16" o.c., at all walls having vertical reinforcing grouted-in-place.
 - b. Truss type with diagonal cross rods spaced not more than 16" o.c. at all other walls.
 - c. Number of Side Rods: Single pair for single wythe masonry and as indicated for multi-wythe masonry, or if not otherwise indicated, one side rod for each brick wythe and one side rod for each face shell of each concrete masonry wythe.
 - 2. For multi-wythe walls where indicated provide tab type consisting of single pair of side rods and continuous diagonal truss-type ties. Space side rods for embedment within each face shell of back-up wythe and extend ties to within 1" of exterior face of facing wythe.
 - a. At exterior cavity wall construction provide units with adjustable 2-piece triangular ties spaced at 16" o.c.
 - 3. Wire Sizes: Fabricate with 9-gage side and cross rods, unless otherwise indicated.
 - 4. Wire Finish: Provide manufacturer's standard mill galvanized finish except as otherwise indicated below.
 - a. For exterior walls hot-dip galvanize joint reinforcing after fabrication to comply with ASTM A 153, Class B-2 coating (1.5 oz. per sq. ft.).

C. Individual Wire Ties for Masonry:

1. Fabricate from 3/16" cold-drawn steel wire, ASTM A 82, unless otherwise indicated, of the length required for proper embedment in wythes of masonry.
2. For use with hollow masonry units cells laid vertical, provide rectangular shaped ties.
3. For use with solid masonry units, provide ties with ends bent to 90 deg angles to form hooks not less than 2" long, 2-piece type.
 - a. Where spacing and back-up joints do not align, provide either offset or adjustable 2-piece ties.
4. For exterior walls, fabricate from steel wire with 1.5 oz. hot-dip zinc coating, ASTM A 153 Class B-2, or fabricate from steel wire with not less than 7-mil copper coating, ASTM B 227, Grade 30 HS.

D. Anchors and Ties:

1. Provide straps, bars, bolts and rods fabricated from not less than 16 ga. sheet metal or 3/8" diameter rod stock, unless otherwise indicated.
2. Flexible Anchors: Where masonry is indicated to be anchored to structural framework with flexible anchors, provide 2-piece anchors which will permit horizontal and vertical movement of masonry but will provide lateral restraint.
3. Metal Fasteners for steel studs: Steel drill screws, #10 diameter x length required to penetrate studs
4. For devices which extend into exterior wythe, fabricate from steel with hot-dip galvanized coating, ASTM A 153, Class B-2.

E. Concrete Inserts for Masonry:

1. Unit Type: Furnish cast iron or malleable iron inserts of the type and size shown, hot-dip galvanized after fabrication with 1.5 oz. zinc coating, ASTM A 153, Class B-2.
2. For installation of concrete inserts, see Concrete Sections of these Specifications. Advise Concrete Installer of specific requirements regarding his placement of inserts which are to be used by the Masonry Installer for anchoring of Masonry Work.
3. Flashings for Masonry: (built-in and concealed).
4. Copper-Fabric Laminate: Copper sheet weighing 3 oz. per square foot, bonded with asphalt between 2 layers of cotton fabric cloth.
5. Adhesive for Flashing: Of type recommended by manufacturer of flashing material for use indicated.

F. Miscellaneous Masonry Accessories:

1. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 for bars No. 3 to No. 18.
2. Non-Metallic Expansion Joint Strips: Provide premolded, compressible, elastic fillers of foam rubber, neoprene, or extruded plastic.
3. Bond Breaker Strips: 15-lb. asphalt roofing felt complying with ASTM D 226, or 15-lb., coal-tar roofing felt complying with ASTM D 227.
4. Plastic Weepholes: Unless otherwise indicated, provide one piece flexible extrusion medium density polyethylene plastic full depth to form weepholes at top and base of walls.
5. Asphalt Sealer: Asphalt based sealer intended for use in sealing metal from moisture penetration and corrosive.
6. Insulation: Specified in Division 7.
7. Washed Pea Stone: Provide 1/4" - 3/8" diameter, smooth, washed clean pea gravel for placement at base of masonry wall cavities and over continuous flexible fabric flashings wherever occurring in cavities, typical. Washed pea stone shall be of sufficient depth to cover weep joints.

2.05 MORTAR AND GROUT MIXES

- A. Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents.
 - 1. In no case shall calcium chloride be used in mortar or grout.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated.
 - 1. Limit cementitious materials in mortar to Portland cement-lime.
 - 2. Use Type M mortar for masonry below grade and in contact with earth, and where indicated.
 - 3. Use Type S mortar for concrete masonry units and where indicated.
 - 4. Mortar Color: To be selected. Tinted mortar SGS 8SH Dark Chocolate.
- C. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of reinforced and nonreinforced unit masonry. Use grout of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.
- B. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.
- C. Thin Brick: Install in strict conformance with manufacturers written instructions.

3.03 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

- C. Bond Pattern for Exposed Masonry: Lay exposed masonry as shown; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

3.04 MORTAR BEDDING AND JOINTING

- A. Lay brick and solid concrete masonry units with completely filled bed, head and collar joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and foundation walls and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or to be filled with concrete or grout. For starting courses on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- C. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8" joints. Cut joints flush at first course of interior exposed joints to be covered with base. Tool exposed joints slightly concave using a jointer larger than joint thickness. Rake out mortar in preparation for application of caulking or sealants where shown. Vertical joints containing weephole shall remain clear of mortar except at top of wall where weep tubes shall penetrate full depth of tooled, mortar filled joint and where weep joints occur at soldered masonry units.

3.05 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

- A. Use continuous horizontal joint reinforcing embedded in horizontal joints for bond tie between wythes. Install at not more than 16" o.c. vertically as specified. Provide continuity at corners and intersections using prefabricated "L" and "T" units.

3.06 HORIZONTAL JOINT REINFORCING

- A. Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls and 1/2" at other locations. Lap reinforcement a minimum of 6". Do not bridge control and expansion joints with reinforcing, unless otherwise indicated. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- B. Space continuous horizontal reinforcing as follows:
 - 1. For multi-wythe walls (solid or cavity) where continuous horizontal reinforcing acts as structural bond or tie between wythes, space reinforcing as required by code but not less than 16" o.c. vertically.
 - 2. For single-wythe walls, space reinforcing at 16" o.c. vertically, unless otherwise indicated.
- C. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcing placed in 2 horizontal joints approximately 8" apart, both immediately above lintels and below sills. Extend reinforcing a minimum of 2'-0" beyond jambs of the opening, bridging control joints where provided.

3.07 ANCHORING MASONRY WORK

- A. Provide anchoring devices of the type indicated. If not indicated, provide standard type for facing and back-up involved.
- B. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
 - 1. Provide an open space not less than 1" in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.
 - 2. Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise indicated.
 - 3. Space anchors as shown, but not more than 24" o.c. vertically and 36" o.c. horizontally.
- C. Lintels:
 - 1. Install loose steel lintels or precast units where shown and where required for support of construction above with a minimum bearing of 8" at each jamb, unless otherwise indicated.
- D. Control and Expansion Joints:
 - 1. Provide vertical expansion, control and isolation joints in masonry where shown on Drawings. Build in related masonry accessory items as the masonry work progresses.

3.08 FLASHING OF MASONRY WORK

- A. Provide concealed flashings in masonry work at, or above, all shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior.
- B. Prepare masonry surfaces to be smooth and free from projections which could puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar.
- C. Extend flashings the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from a line 1/2" in from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills turn up ends not less than 2" to form a pan.
 - 1. Provide weepholes in the head joints of the same course of masonry bedded in the flashing mortar.
 - 2. Install flashings in accordance with manufacturer's instructions.
 - 3. Install reglets and nailers for flashing and other related work where shown to be built into masonry work.

3.09 REPAIR, POINTING AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weepholes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.
- C. Clean exposed masonry surfaces by the bucket and brush hand cleaning method or by high pressure water method. Comply with requirements of BIA Technical Notes.
 - 1. Use commercial cleaning agents (Eaco Chem NMD 80) in accordance with manufacturer's instructions.
 - 2. Clean thin brick according to manufacturer's written instructions
- D. Clean exposed CMU masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings.

END OF SECTION

SECTION 044313 - STONE MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

- A. Thin stone masonry veneer set in mortar over an exterior substrate of concrete. Refer to details
- B. Mortar and pointing mortar.
- C. Waterproof Membrane.
- D. Fasteners/Anchors

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A108.01 – General Requirements: Subsurfaces and Preparations by Other Trades.
 - 2. ANSI A108.02 – General Requirements: Materials, Environmental, and Workmanship.
 - 3. ANSI A118.4 – American National Standard for Latex-Portland Cement Mortar.
 - 4. ANSI A118.9 – American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.
- B. ASTM International (ASTM):
 - 1. ASTM A653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
 - 2. ASTM C91 – Standard Test Method for Masonry Cement.
- C. Masonry Standards Joint Committee (MSJC)
 - 1. ACI 530.1/ASCE 6/TMS 602 – Specification for Masonry Structures; Cold and hot weather requirements for mortar and grout.
- D. National Concrete Masonry Association (NCMA)
 - 1. TEK 10-2B – Control Joints for Concrete Masonry Walls.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 Submittal Procedures.
- B. Product Data: For materials other than water and aggregates.
- C. Samples of stone masonry units, pointing mortar color, and sealant colors.

1.4 QUALITY ASSURANCE

- A. Mock-up:
 - 1. Install mock-up using approved thin stone veneer including related accessories.
 - a. Mock-up size: 2 feet by 6 feet long.
 - b. Mock-up may remain as part of the work.
- B. Pre-installation Conference:
 - 1. Refer to Section 01 31 19 Project Meetings.
 - 2. Hold a pre-installation conference, prior to start of stone veneer installation. Attendees shall include Contractor, Architect, installer, Owner's Representative, and manufacturer's designated representative.
 - 3. Review related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of thin stone veneer and components, installer's qualifications, equipment, and coordinate methods, procedures and sequencing requirements for installation and protection.

1.5 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or build on frozen mortar beds.
- B. Exterior Weather Limitations:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Do not apply mortar when substrate temperatures exceed 90 deg F.

1.6 WARRANTY

- A. Provide mortar manufacturer's standard warranty of installation systems, including setting mortar, pointing mortar and waterproof membrane, for a period of 25 years over cast-in-place/cmu masonry and 15 years for exterior building base. Warranty shall cover materials and labor.

PART 2 - PRODUCTS

2.1 STONE MASONRY VENEER

- A. Manufacturer: Swenson Granite Works, Westbrook Maine or equal.
- B. Substitution Limitations:
 - 1. Submit written request for approval of substitutions to the Architect a minimum of 14 days prior to the date for receipt of bids. Include the following information:
 - a. Name of the materials and description of the proposed substitute.
 - b. Drawings, cut sheets, performance and test data.
 - c. List of projects of similar scope.
 - d. Test reports indicating compliance with the performance criteria.
 - e. Other information necessary for evaluation.
 - 2. After evaluation by Architect, approval will be issued via addendum. No verbal approval will be given.
 - 3. Substitutions following award of contract are not allowed except as stipulated in Division 01 – General Requirements.
- C. Product, provide the following:
 - 1. Stone: Granite
 - a. Pattern: Refer to drawings
 - b. Thickness: Refer to drawings.
 - c. Finish: Thermal
 - d. Color: Architect choose from range of samples of Caledonia.

2.2 MORTAR SETTING MATERIALS

- A. Mortar Bed: Polymer modified Portland cement with graded aggregates; factory prepared per ANSI A118.4.
 - 1. Product: Laticrete International, Inc.; Premium Mortar Bed.

- B. Thin Bed Mortar: Polymer modified mortar; factory prepared per ANSI A118.4.
 - 1. Product: Laticrete International, Inc.; Masonry Veneer Mortar or approved equal.
- C. Pointing Mortar:
 - 1. Pointing Mortar: ASTM C91, factory prepared cementitious mortar. "Masonry Pointing Mortar" as manufactured by Laticrete International, Inc.
 - 2. Mortar additive: Liquid used in place of water which inhibits staining caused by bacteria, mold and mildew. "Mortar Enhancer" as manufactured by Laticrete International, Inc.
- D. Flashing Mortar: ANSI A118.10, multi-component, factory prepared, epoxy based waterproofing. "Latapoxy Waterproof Flashing Mortar" as manufactured by Laticrete International, Inc.
- E. Water: Potable.

2.3 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions. Discard mortars and grout if they have reached their initial set before being used.
- B. Mortar Bed: Mix fortified mortar and water to a creamy consistency, per manufacturer's instructions.
- C. Thin Bed Mortar: Mix thin bed mortar and water to a creamy consistency, per manufacturer's instructions.
- D. Pointing Mortar: Mix pointing mortar with mortar additive per manufacturer's instructions.
- E. Flashing Mortar: Mix per manufacturer's instructions.

2.4 MEMBRANES

- A. Self-Adhering Waterproof Membrane: ASTM D 1970 Polyethelene faced min 40 MIL thick, load-bearing, single component, SBS modified asphalt adhesive.
 - 1. Product: Grace, W. R. & Co; Grace Ice and Water Shield.
- B. Cleavage Membrane: 4 mil polyethylene film complying with ASTM D4397.

- C. Expansion Joint: Fabricated from aluminum, 2 piece construction with slip-joint and square edge reveal, provide perforated flanges.
- D. Mortar Deflection and Rain Screen Barrier: 25 inch thick polypropylene meeting requirements of ASTM D-5261, D-6525 Type 6 MM
 - 1. Product: Mortairvent Rainscreen manufactured by Advanced Building Products or approved equal.
 - 2. Accessories: Required by manufacturer for complete installation.

2.5 FLASHING MATERIALS

- A. Sheet Metal Flashing: Stainless steel, 2D finish and not less than 0.025 inch thick, meeting requirements of ASTM A240 or ASTM A666, Type 304.

2.6 ACCESSORIES

- A. Adjustable stainless steel anchors and fasteners
- B. Sealant: [Refer to Section 07 92 00 – Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are complete and ready for the work of this Section.
- B. Substrates:
 - 1. Verify that surfaces are free of dust, dirt, oil, curing compounds and efflorescence.
- C. Substrate tolerances: Maximum of 1/16 inch in 1 foot, with a maximum of 1/32 between adjoining edges.
- D. Verify that weather barrier and mortar deflection product installation is complete and ready for the work of this Section.
- E. Beginning of installation means acceptance of surface conditions.

3.2 FLASHING INSTALLATION

- A. Install flashing to direct water to building exterior.
- B. Install flashing plumb and level, using longest practical lengths to minimize number of lap joints.

- C. Secure flashing to substrate using screw fasteners.
- D. Form neat and aligned 4 inch lap joints in horizontal flashing, seal laps with flashing mortar.

3.3 STONE VENEER INSTALLATION - GENERAL

- A. Install stone veneer in accordance with ANSI A108 and as indicated below.
- B. Install lathing and mortar bed in accordance with ANSI A108.01 and as indicated below.
- C. Use manufacturer's standard stone veneer corner units at all outside corners.
- D. Do not install chipped or cracked stone veneer.
- E. Expansion Joints:
 - 1. Layout expansion joints prior to beginning installation of stone masonry veneer.
 - 2. Place expansion joints where indicated on Drawings and in accordance with BIA Technical Note 18A, TCNA EJ171 and NCMA TEK 10-2B.
 - 3. Fill expansion joints with sealant as recommended by sealant manufacturer.

3.5 INSTALLATION – REINFORCED LEVELING MORTAR BED METHOD

- A. Reinforced leveling mortar bed over **framed wall and exterior grade sheathing**:
 - 1. Install stone veneer in accordance with TCNA Installation Method W201E and Laticrete Architectural Guidebook v2.0.5; Execution Statement Number **[MVIS-E101] [MVIS- E104] [MVIS-101]**.
 - 2. Install Drainage Membrane per the requirements of manufacturer.
 - 3. Refer to drawings for installation details
 - 4. Waterproof Membrane:
 - a. Install waterproof membrane as noted on the drawings and in accordance with the manufacturers written instructions.
 - 5. Lay out stone veneer prior to placement on substrate to minimize cutting of stone veneer. Take into account openings, movement joints, and offsets.

3.6 PROTECTION

- A. Protect completed work minimum 72 hours or until mortar bed and grout have fully cured.
- B. Protect portland cement based mortars and grouts from direct sunlight, radiant heat, forced ventilation (heat and cold), and drafts until cured to prevent premature evaporation of moisture.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #040416

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes structural steel and architecturally exposed structural steel.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
 - 2. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.
 - 3. Division 9 Section "Painting" for surface preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
 - 2. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.
- B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.
- C. Structural System Design performed using Allowable Stress Design (ASD). Connection Design shall utilize same.

1.6 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members and connections of the Seismic-Load-Resisting System.
 - 6. Indicate locations and dimensions of protected zones.
 - 7. Identify demand critical welds.
- D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.

- E. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer licensed in the project jurisdiction and responsible for their preparation.
- F. Certification:
 - 1. Submit a letter of certification from the material fabricator sealed by a professional engineer licensed to practice in the Project State attesting that all shop drawings were prepared under his direct supervision.
 - 2. Submit certification that field welders are AWS certified.
- G. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- H. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
 - 1. Edit list below to suit requirements. Add twist-off tension control bolts or other alternative design bolts, if required.
 - 2. Structural steel, including chemical and physical properties.
 - 3. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 4. Direct-tension indicators.
 - 5. Shop primers.
 - 6. Nonshrink grout.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Nonshrink grout.
- F. Survey of existing conditions.

- G. Source quality-control reports.
- H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
 - 1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
 - a. Category: Category II, complex steel building structures.
 - b. Fabricator shall be registered with and approved by authorities having jurisdiction.
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. Delete references below if not applicable. Add others as required.
 - 2. AISC's "Code of Standard Practice.
 - 3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 - 4. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 - 5. AISC's "Seismic Provisions for Structural Steel Buildings."
 - 6. ASTM A 992/A 992M "Specifications for High-Strength Low-Allow Columbium-Vanadium Structural Steel"
 - 7. ASTM A 307 "Specifications for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength"
 - 8. ASTM A 325 "Specifications for Structural Bolts, Steel Heat Treated, 120/105 ksi Minimum"
 - 9. ASTM A 500 "Specifications for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"
 - 10. **ASTM A 6** "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
 - 11. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 12. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

- E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
 - 1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- F. Structural Steel Painting Manual: Comply with applicable provisions of the "Structural Steel Painting Manual.
- G. Structural Steel Painting Council: Comply with provisions as follows:
 - 1. SSPC-SP3 - Power Tool Cleaning
 - 2. SSPC-SP6 – Commercial Blast Cleaning
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.10 SEQUENCING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel W (rolled wide flange) Shapes: As follows:
 - 1. High-Strength, Low-Alloy Columbium-Vanadium Steel: **ASTM A 992**, Grade 50.

- B. Structural Steel Shapes (except rolled wide flange “W” shapes), Plates, and Bars: As follows:
1. Carbon Steel: **ASTM A 36**.
- C. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B (Fy = 46 ksi).
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B.
1. Weight Class: Standard.
 2. Select steel pipe finish from below.
 3. Finish: Black.
- E. Anchor Rods, Bolts, Nuts, and Washers: As follows:
1. Anchor Rods: **ASTM F 1554, Grade 105**; carbon-steel, hex-head bolts; and carbon-steel nuts.
 2. Headed Bolts: **ASTM A 325**, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
 3. Headed Bolts: **ASTM A 490**, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
 4. AISC's "Manual of Steel Construction, Load and Resistance Factor Design," Vol. 2, states that base plate washers are usually furnished from ASTM A 36 (ASTM A 36M) steel plate.
 5. Washers: **ASTM A 36**.
- F. High-Strength Bolts, Nuts, and Washers: **ASTM A 325**, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: Plain, uncoated.
 2. Direct-Tension Indicators: ASTM F 959, Type 325.
 3. Optional: Snap off tension indicating high-strength bolts certified to provide the minimum fastener tension per AISC “Specifications for Structural Joints Using ASTM A 325 or ASTM A 490”
 - a. Finish: Plain, uncoated.
- G. High-Strength Bolts, Nuts, and Washers: **ASTM A 490**, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.
1. Direct-Tension Indicators: ASTM F 959, Type 490, uncoated.
 2. Optional: Snap off tension indicating high-strength bolts certified to provide the minimum fastener tension per AISC “Specifications for Structural Joints Using ASTM A 325 or ASTM A 490”
- H. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- I. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

- A. Primer: Exterior exposed steel shall be sandblasted to SSPC-SP6 and shop painted with primer paint - TNEMEC Chem-Prime #37-78 Gray, or approved equal.
- B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer, except that primer used shall conform to AISC specifications and shall be suitable for top coating. (At areas where structural steel is scheduled to receive a finish coat, verify compatibility of primer)

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
 - 1. Camber structural steel members where indicated.
 - 2. Identify high-strength structural steel according to **ASTM A 6** and maintain markings until steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 - 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 - 1. Tolerance limits for architecturally exposed structural steel are generally one-half those permitted by AISC for structural steel. Revise when stricter limits are required.
 - 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded.
- D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

2.5 SHOP CONNECTIONS

- A. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 1. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds **1/2 inch** and larger. Grind flush butt welds. Dress exposed welds.
 - 2. Partial penetration groove welds are not permitted for connections on this project.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches**.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed-on fireproofing.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
 - 1. SSPC-SP 3 "Power Tool Cleaning."
 - 2. SSPC-SP 6 "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than **1.5 mils**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.7 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
 2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 4. Ultrasonic Inspection: ASTM E 164.
- F. In addition to visual inspection, shop-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:
1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
 2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

PART 3 - EXECUTION

2.8 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

2.9 WORKMANSHIP - GENERAL

- A. Workmanship shall be equal to the best practice in modern structural shops. Material shall be clean and straight. All holes shall be accurately drilled or punched. Burning and drifting to enlarge holes will not be permitted. Holes that must be enlarged shall be reamed. Particular care shall be taken to protect all materials from injury of any kind, either in transportation, storage or erection. Material that is damaged must be replaced by perfect material or repaired in

a manner approved and accepted by the Engineer. The use of drift pins will be allowed only to bring together the several parts, and they must not be driven with such force as to distort or injure the material. Material that has been distorted by drift pins will not be accepted.

- B. All shop and field welding shall be performed by certified welders in conformance with American Welding Society's "Code for Arc and Gas Welding in Building Construction."
- C. No holes shall be burned in steel members under any circumstances without express approval and instructions from the Engineer.
- D. Bolted members shall have all parts well pinned-up and firmly drawn together. Abutting joints shall be dressed or cut true and straight and fitted closely together. In compression joints, depending upon contact bearing, the surfaces shall be truly faced so as to have even bearing after they are bolted up complete; and, when properly aligned, the several pieces forming one built-up member shall be straight and shall fit closely together. Finished members shall be free from twists, bends or open joints. Abutting joints in compression members faced for bearing shall be spliced sufficiently to hold the connecting members accurately in place. All other joints in bolted work, whether in tension or compression, shall be fully spliced.

2.10 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

2.11 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - 3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Protect steel embedded in concrete or gravel with a liberal brushed coat of asphalt mastic.

2.12 FIELD CONNECTIONS

- A. Install and tighten non high-strength bolts, except where high-strength bolts are indicated.
- B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds **1/2 inch** and larger. Grind flush butt welds. Dress exposed welds.
 3. Partial penetration groove welds are not permitted for connections on this project.

2.13 FIELD QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 - 4. Ultrasonic Inspection: ASTM E 164.
- F. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:
 - 1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

2.14 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel are included in Division 9 Section "Painting."
- C. Finish Painting: Finish painting of steel surfaces are included in Division 9 "Painting"

END OF SECTION

SECTION 052100 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Open-web K-series steel joists.
 - 2. KCS-type, open-web K-series steel joists.
 - 3. Joist accessories
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for installing bearing plates in concrete.
 - 2. Division 5 Section "Metal Fabrications" for furnishing steel bearing plates.
 - 3. Division 9 Section "Painting" for prime painting.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special "SP" joists and connections capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As specified on structural drawings.

1.4 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. Shop Drawings: Show layout, mark, number, type, location, and spacing of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
 - 1. Submit a letter of certification from the material fabricator sealed by a professional engineer licensed to practice in the State of Massachusetts attesting that all shop drawings were prepared under his direct supervision.
 - 2. Submit design calculations from the material fabricator sealed by a professional engineer licensed to practice in the State of Massachusetts for all joist types and associated connections.

3. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
 1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
 2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer licensed to practice in the State of Massachusetts.
 3. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of joists that are similar to those indicated for this Project in material, design, and extent.
- B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.
- C. Steel Structures Painting Council - SSPC-PS 14.01 - Steel Joist Shop Paint System.
- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Handle, transport, and store steel joists, steel joist substitutes, at the job site in a manner to prevent permanent distortion of any part or other damages affecting their structural integrity.

Replace damaged items that cannot be restored to like-new condition. Store all items off the ground in a well-drained location protected from the weather and easily accessible for inspection and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/240 of the span.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.
- B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated.
- C. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain, uncoated.
- D. Welding Electrodes: Comply with AWS standards.

2.3 PRIMERS

- A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

2.4 OPEN-WEB K-SERIES STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- C. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- D. Camber joists according to SJI's "Specifications."
- E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 JOIST ACCESSORIES

- A. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."
- B. Steel bearing plates with integral anchorages are specified in Division 5 Section "Metal Fabrications."
- C. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.
- D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.6 CLEANING AND SHOP PAINTING

- A. Clean and prime steel joists, and steel joist substitutes, in accordance with SSPC-PS 14.01, Steel Joist Shop Paint System, except that paint shall conform to SJI specifications and shall be suitable for top coating. (At areas where steel joists, steel joist substitutes, are scheduled to receive a finish top coating, verify compatibility of primer.)
- B. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- C. Painting of joists and joist accessories is specified in Division 9 Section "Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds [and high-strength bolted connections.
- B. Field welds will be visually inspected according to AWS D1.1.
- C. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:
 - 1. Radiographic Testing: ASTM E 94 and ASTM E 142.
 - 2. Magnetic Particle Inspection: ASTM E 709.
 - 3. Ultrasonic Testing: ASTM E 164.
 - 4. Liquid Penetrant Inspection: ASTM E 165.
- D. Bolted connections will be visually inspected.

1. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."
- E. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.
- F. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.
 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, which ensure joists and accessories, are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 053100 - STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Roof deck.
 - 2. Floor Form deck.
 - 3. Elevator Cap deck.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, and deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 PROJECT CONDITIONS

- A. Design:
 - 1. Steel deck shall be designed in accordance with the AISI "Specifications for the Design of Cold-Formed Steel Structural Members." Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical.
 - 2. Design Loads: As specified on the drawings.

PART 2 - PRODUCTS

2.1 ROOF DECK

- A. Steel Roof Deck (Main Roof and Stair Tower Roof): Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer. Color: Manufacturer's standard.
 - 2. Deck Profile: Type B Deck.
 - 3. Profile Depth: 1 ½ inches
 - 4. Design Uncoated-Steel Thickness: 20 Gage
 - 5. Span Condition: Double Span.
 - 6. Field, Perimeter and Corner Fastening:
 - a. Field: 5/8" puddle welds at 36/7 spacing
 - b. Perimeter/Corners: 5/8" puddle welds at 36/7 spacing
 - 7. Side Laps: Fasteners #12 TEK screws @ 16" on-center spacing.
- B. (Elevator Cap) Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 29, the minimum section properties indicated, and the following:
 - 1. Galvanized Steel Sheet: ASTM A1008-00, Grades C and D, or from A653-00, Structural Steel with a minimum yield strength of 40 KSI.
 - 2. Profile Depth: 1 ½ inches.

3. Design Uncoated-Steel Thickness: 20 Gage Composite
4. Span Condition: Single span.
5. Side Laps: Fasteners #12 TEK screws @ 16" on-center spacing. .
6. Slab Reinforcement: 6 x 6 xW1.4 x W1.4 WWM
7. Fastening: 5/8" puddle welds on 36/7 pattern.

2.2 FLOOR DECK

- A. Form Floor Deck (2nd Floor): Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized Steel Sheet: ASTM A1008-00, Grades C and D, or from A653-00, Structural Steel with a minimum yield strength of 40 KSI.
 2. Profile Depth: 1 ½"
 3. Design Steel Thickness: 22 gage; 0.0295 inch; $S_p = 0.198$; $S_n = 0.189$
 4. Span Condition: Double span.
 5. Side Laps: Overlapped.
 6. Slab Reinforcement: 6 x 6 xW2.9 x W2.9 WWM
 7. Fastening: 5/8" puddle welds on 36/5 pattern, with washers.
- B. Form Floor Deck (3rd & 4th Residential): Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized Steel Sheet: ASTM A1008-00, Grades C and D, or from A653-00, Structural Steel with a minimum yield strength of 40 KSI.
 2. Profile Depth: 1"
 3. Design Steel Thickness: 22 gage; 0.0295 inch; $S_p = 0.130$; $S_n = 0.134$
 4. Span Condition: Double span.
 5. Side Laps: Overlapped.
 6. Slab Reinforcement: 6 x 6 xW2.9 x W2.9 WWM
 7. Fastening: 5/8" puddle welds on 36/5 pattern, with washers.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Adjusting Plates: Provide adjusting plates or segments of roof units in locations too narrow to accommodate full-size roof units. As far as practical, provide plates of the same gauge and configuration as the roof units. Plates of predetermined sizes shall be factory cut.
- C. Reinforcing Plates: Provide .057" thick reinforcing plates for all openings less than 12 inches in diameter. Length and width of plates as required satisfying The Steel Deck Institute requirements.

- D. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- E. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- G. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- H. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- I. End Closures: Provide end closures of minimum 22 gauge to close the ends at end walls, eaves, and openings through the roof.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate decking bundles to prevent overloading of supporting members.
 - 1. Exercise special care not to damage the material or overload the decking during the entire construction period. The maximum uniform distribution storage load shall not exceed the design live load.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical. Do not use unanchored deck units as a work or storage platform.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking. Reinforce and frame openings through roof in accordance with the drawings for rigidity and load-carrying capacity. Holes or other openings required for the work of other trades shall be drilled or cut and reinforced by the respective trades; the deck manufacturer and the Engineer shall approve such holes or other openings larger than 6 inches in diameter.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 DECK INSTALLATION

- A. Immediately after placement and alignment, and after inaccuracies have been corrected, permanently fasten steel roof deck and floor deck units in place. Clamp or weight deck units to provide firm contact between deck units and structural supports while fastening is being performed. Decking shall be fastened as recommended by the manufacturer unless indicated otherwise on the drawings.
- B. End Bearing: Install deck ends over supporting frame as per drawings or unless otherwise noted, with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped **2 inches** minimum roof decks.
 - 2. End Joints at Elevator shaft roof: Continuous over single span
- C. Roof Sump Pans: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld at each corner.
- D. Miscellaneous Roof Deck Accessories: finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

3.4 FIELD QUALITY CONTROL

- A. Inspect the decking top surface for flatness after installation. Place a four-foot straightedge across the decking ribs over the structural supporting members at all locations. If the straightedge fails to touch the entire top surface of the decking or if top surfaces of abutting units are not in alignment, corrective measures or replacement shall be provided. After corrective measures or replacement has been performed, the decking shall be reinspected.
- B. Field welds will be subject to inspection.
- C. Testing agency will report test results promptly and in writing to Contractor and Engineer.

- D. Remove and replace work that does not comply with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior non-load-bearing curtain-wall framing.
2. Miscellaneous support framing at exterior ceilings and soffits, as detailed.
3. Ceiling joist framing.
4. Soffit framing.
5. Perimeter eyebrow outrigger side wall framing elements..

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
2. Division 6 Section "Rough Carpentry" for wall sheathing, or roof sheathing using wood-based structural-use panels.
3. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing metal-stud framing and ceiling-suspension assemblies.

1.2 DEFINITIONS

A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than ninety-five percent (95%) of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated as indicated on the structural drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Curtain-Wall Framing:
 - 1) EIFS and Metal Panel: Horizontal deflection of 1/360 of the wall height for siding.
 - 2) Brick, Manufactured Stone, and Fiber Cement Panel: Horizontal deflection of 1/600 of the wall height for siding

- b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height.
 - c. Roof sloped framing at parapet: Horizontal deflection of 1/240 of the horizontally projected span.
 - d. Exterior ceiling and soffit framing: Vertical deflection of 1/240 of the ceiling joist span.
 - e. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120°F°.
 4. Design wall framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Downward movement of 3/4 inch.
- B. Design exterior non-load-bearing curtain-wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.
1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Include complete details for all member connections at openings and other discontinuities of the wall system.
 3. Specify connections to supports at top and bottom of wall including spacings at jambs of openings.
 4. All components shall conform to AISI "specifications for design of cold-formed steel structural members" and ASTM A446. All interior stud wall components, ceiling joists, rafters and accessories.
 5. All stud wall components, ceiling joists, rafters and accessories shall be G-60 galvanized (ASTM A525), unless noted otherwise on drawings.
- C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.

1. Submit letter of certification from the material fabricator sealed by a professional engineer who is legally qualified to practice in jurisdiction where Project is located attesting that the shop drawings were prepared under his direct supervision.
 2. For cold-formed metal framing indicated to comply with design loads, include structural analysis data (design calculations) signed and sealed by the professional engineer legally qualified to practice in jurisdiction where Project is located, and responsible for their preparation.
- D. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements.
- E. Welding Certificates: Copies of certificates for welding procedures and personnel.
- F. Qualification Data: For firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
1. Steel sheet.
 2. Expansion anchors.
 3. Power-actuated anchors.
 4. Mechanical fasteners.
 5. Vertical deflection clips.
 6. Horizontal drift deflection clips
 7. Miscellaneous structural clips and accessories.
- H. Research/Evaluation Reports: Evidence of cold-formed metal framing’s compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Engineering Responsibility: Engage a qualified professional engineer to prepare design calculations, Shop Drawings, and other structural data licensed in the project jurisdiction.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

- E. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.
- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel", and AWS D1.3, "Structural Welding Code--Sheet Steel".
- G. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual", or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
- H. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" or "Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members" and the following for calculating structural characteristics of cold-formed metal framing:
- I. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- J. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for connector devices is based on The Steel Network, Inc. as indicated in other Part 2 Articles. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Dale Industries, Inc. Retain above for nonproprietary or below for semi-proprietary Specification. Refer to Division 1 Section "Materials and Equipment."
 - 2. ClarkDietrich Building Systems, Inc.
 - 3. MarinoWare; Div. of Ware Industries, Inc.
 - 4. The Steel Network

2.2 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST50H for 54 MIL or heavier material.
 - 2. Grade: ST33H for 33 and 43 MIL gauge material.
 - 3. Coating: As noted in 1.4D.6 above.

- B. Steel Sheet for Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 50, Class 1 for 54 MIL or heavier material.
 - 2. Grade: 33 for 33 and 43 MIL gauge material.
 - 3. Coating: As noted in 1.4D.6 above.
- C. Cold-Formed Steel Framing Design Standards:
 - 1. Floor and Roof Systems: AISI S210.
 - 2. Wall Studs: AISI S211.
 - 3. Headers: AISI S212.
 - 4. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 EXTERIOR/NON-LOAD-BEARING FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM A 1003, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Min. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, complying with ASTM A 1003, and as follows:
 - 1. Minimum Uncoated-Steel Thickness: Matching steel studs.
 - 2. Min. Flange Width: 2 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web. Mechanical attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement; 68 mils minimum thickness, size as required by structural design calculations. Use only vertical deflection connection products that have a valid ICC ES Report complying with ICC Acceptance Criteria AC261, such as ICC-ESR-1903 or equivalent.
 - 1. Basis-of-Design Product: The Steel Network, Inc. VertiClip including step bushings.
 - a. Exterior Head of Wall: The Steel Network, Inc. VertiClip SL.
 - b. Exterior Head of Wall Preassembled with Track: The Steel Network, Inc. VertiTrack VTX.

- c. By-pass Structural Pour Stop at Floor Slab: The Steel Network, Inc. VertiClip SLB.
 - d. By-pass Floor Slab or Structure: The Steel Network, Inc. VertiClip SLT.
 - e. By-pass Structure: The Steel Network, Inc. VertiClip SLS.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
- 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1 inch plus the design gap for one-story structures.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, un-punched, with stiffened flanges, complying with ASTM C 955, and as follows:
- 1. Minimum Uncoated-Steel Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.

2.5 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
- 1. Minimum Base-Metal Thickness: 0.0329 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.

2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
- 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. End clips.
 - 5. Foundation clips.
 - 6. Gusset plates.
 - 7. Stud kickers, knee braces, and girts.
 - 8. Joist hangers and end closures.

9. Hole reinforcing plates.
10. Backer plates.

C. Special Solid Backing Support Plates: The Steel Network, Inc. BackIt Rigid Wall Backing plates designed to provide a solid backing support for handrails, wall-mounted shelving and similar equipment. ASTM A653/A653M structural steel, zinc coated of grade and coating as follows:

1. Grade 50 (340), Class 1 or 2.
2. Coating: G-60 steel
3. Minimum Design Thickness of 0.0346 inch (0.879 mm).

2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to five (5) times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to ten (10) times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- D. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure.
 1. Construction: Slotted galvanized steel angle with step bushing to prevent over tightening of fasteners.
 2. Vertical Deflection: 1-1/2 inches total travel .
 3. Product: Subject to compliance with requirements, provide VertiClip, Signature Industries, 919-844-0789.
 4. Series: SL, SDL, SLB, AND SLS as required by attachment condition.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: [SSPC-Paint 20 or DOD-P-21035] [ASTM A 780].
- B. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multi-monomer plastic, non-leaching.

- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION TOLERANCES

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding, screw fastening; clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to ASTM C 1007, unless more stringent requirements are indicated.
- B. Install field-fabricated, cold-formed framing and securely anchor to supporting structure.
- C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three (3) exposed screw threads.
- D. Install framing members in one- (1) piece lengths, unless splice connections are indicated for track or tension members.
- E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- G. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- I. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 NON-LOAD-BEARING CURTAIN-WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Select fastening of studs to top track only if required. Do not fasten studs to deflection track, such as in infill curtain-wall framing.
- C. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches unless otherwise indicated.
- D. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- E. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Connect drift clips to cold-formed metal framing and anchor to building structure.
- F. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 54 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track.
 - 2. Bridging may be either of the following:
 - a. Bridging: Cold-rolled steel channel mechanically fastened to webs of punched studs.
 - b. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 1) Space solid blocking at 8 feet on center.

3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.
- B. Field and shop welds will be subject to inspection and testing.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace Work that does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touch-up Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.
- C. Protect paper-surfaced gypsum sheathing that will be exposed to weather for more than thirty (30) days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier. Apply covering immediately after sheathing is installed.
- D. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.
- E. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Steel pit ladder and roof access ladders.
2. Support angles for elevator door sills.
3. Steel framing and supports for countertops.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Sump pit covers.
7. Elevator hoist beam.
8. Miscellaneous metal trim.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural-steel framing system components.
2. Division 5 Section "Metal Stairs" for metal-framed stairs with metal pan, metal plate, or grating treads.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1. Provide templates for anchors and bolts specified for installation under other Sections.

C. Samples for Verification: For each type and finish of extruded nosing and tread.

D. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project

names and addresses, names and addresses of architects and owners, and other information specified.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel".
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel".
 - 3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.5 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- D. Steel Bars for Gratings: ASTM A 36/A 36M.
- E. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- F. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).
- G. Gray-Iron Castings: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.
- H. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- I. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

- A. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carboline 621; Carboline Company.
 - b. Catha-Coat 302H; ICI Devoe Coatings.
 - c. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.
 - d. Tneme-Zinc 90-97; Tnemec Company, Inc.
- B. Galvanizing Repair Paint: High zinc-dust content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
- G. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
- H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).
- I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six (6) times the load imposed when installed in unit masonry and equal to four (4) times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).
 - 3. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hilti Kwik-Bolt Stud Anchors.
 - b. Red Head Wedge Anchors.
 - c. Rawl Power-Fast Anchors.
 - d. Fastenal Stud Anchors.
- J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.
- K. Adhesive Anchors: Threaded anchors with a chemical capsule containing prepared amounts of liquid polyester resin, quartz aggregate, and a catalyst. Size and embedment depth shall be as noted on the drawings, or if not noted, as required to withstand required loading. Acceptable products include, but are not limited to:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hilti HVA Adhesive Anchors.
 - b. Red Head Redi-Chem Anchors.
 - c. Rawl Needle-Capsule Anchors System.
 - d. Fastenal Chemical Capsule Anchors.

L. Sleeve Anchors: Hilti with Hex Nut (HX). Provide tamper-proof nut as indicated.

M. Renovation Anchors: Hilti, HIT C-20 system, female type.

2.5 GROUT

- A. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum twenty-eight (28) day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.7 FABRICATION, GENERAL

- A. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for re-assembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120°F (67°C), ambient; 180°F (100°C), material surfaces.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- J. Remove sharp or rough areas on exposed traffic surfaces.
- K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.8 STEEL LADDERS

- A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
 - 1. Comply with ANSI A14.3, unless otherwise indicated.
 - 2. For elevator pit ladders, comply with ASME A17.1.
- B. Fabricate ladders from materials as detailed on the drawings or if not indicated, as follows:
 - 1. Side rails: Continuous, 1/2 by 2-1/2 inch (12 by 64-mm) steel flat bars, with eased edges, spaced 18 inches (457 mm) apart.
 - 2. Bar Rungs: 3/4-inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.
 - 3. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
 - 4. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
 - 5. Provide non-slip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

C. Galvanize ladders, including brackets and fasteners, in the following locations:

1. Exterior.
2. Interior, where indicated.

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. General: Provide steel framing and supports indicated and as necessary to complete the Work.

C. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
3. Furnish inserts if units must be installed after concrete is placed.

D. Galvanize miscellaneous framing and supports where indicated.

2.10 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. Galvanize miscellaneous steel trim in the following locations:

1. Exterior.
2. Interior, where indicated.

2.11 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.12 STEEL AND IRON FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning".
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning".
- B. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1", for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- C. Galvanizing: Provide coating for iron and steel fabrications applied by the hot-dipped process, Daltagalv by Duncan Galvanizing. The galvanizing bath shall contain high-grade zinc and other earthly materials. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet-kettle process is prohibited. Comply with ASTM A123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified above for setting and grouting bearing and leveling plates.
1. Do not grout baseplates of columns supporting steel girders until girders are installed and leveled.

3.3 ADJUSTING AND CLEANING

- A. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touch-up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting".
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Preassembled steel stairs with metal pans for support of granite treads and risers.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 1. Uniform Load: 100 lbf/sq. ft..
 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.

- D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor is 1.5.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Preassembled Stairs: Commercial class.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- D. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 1. Available Products:
 - a. Five Star Grout by Five Star Products, Inc.
 - b. Masterflow 928 Grout by Master Builders Technologies.
 - c. SonogROUT 10K by Sonneborn.
 - d. 14K Hy Flow by Sonneborn.
- E. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- F. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. Stair Framing:
 - 1. Fabricate stringers of steel channels.
 - a. Provide closures for exposed ends of channel stringers.
 - 2. Construct platforms of steel channel headers and miscellaneous framing members as indicated.
 - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 - 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
- B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch.

1. Steel Sheet: Uncoated cold-rolled steel sheet.
2. Attach risers and subreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
3. Shape metal pans to include nosing integral with riser.
4. Provide subplatforms of configuration indicated or, if not indicated, the same as subreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.7 STAIR RAILINGS

- A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
 1. Configuration: As indicated on the drawings.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- C. Form changes in direction of railings as follows:
 1. As detailed.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 1. Connect posts to stair framing by direct welding unless otherwise indicated.
 2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

- H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

- G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."
- H. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
- B. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:
 - 1. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

PART 4 - PAYMENT PROCEDURES

4.1 APPLICATIONS FOR PAYMENT

- A. Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments. Payment shall be based on percentage of work completed and cost of materials and equipment.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

- B. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

END OF SECTION 055100

SECTION 057310 - TAPER-LOC® DRY GLAZE GLASS RAILING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Monolithic Tempered Glass Dry Glazed Railing Assemblies.

1.2 RELATED SECTIONS

- A. Section 055000 - Metal Fabrications
- B. Section 055100 – Metal Stairs
- C. Section 088000 - Glazing

1.3 REFERENCES

- A. ESR-3269 ICC-ES Evaluation Report, International Code Council Standards for Glass Balustrade Guard Rail Applications
- B. ASTM C 1048 – Standard Specification for Heat Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass
- C. NAAMM Metal Finishes Manual; national Association of Architectural Metal Manufacturers

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements for Handrail Assembly:
 - 1. Support distributed load of 50 pounds per linear foot (0.73kN/M), applied horizontally at right angles in any direction to the handrail.
 - 2. Support concentrated horizontal load of 200 pounds (0.89kN), applied in any direction at any point along handrail system.
 - 3. 50 lbs (0.22kN) on 1 sf (0.093m²) perpendicular to guard at any location
 - 4. Wind loads 25 psf or as otherwise specified.
 - 5. Distributed loads and concentrated loads not to be applied simultaneously.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 3300.
- B. Product Data: Submit Manufacturer’s technical product data for railing components and accessories.
- C. Shop Drawings: Dimensioned drawings of railing assemblies indicating the following:

1. Elevations; include joint locations, transitions, and terminations.
2. Manufacturer's installation and maintenance instructions.

D. Samples of manufacturer's finishes (As selected by Architect.)

1.6 QUALITY ASSURANCE

- A. Components and installation are to be in accordance with state and local building codes.
- B. All components and fittings are furnished by the same manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials properly protected against damage to finished surfaces during transit.
- B. Inspect materials 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 materials at building site under cover in dry location

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: **C.R. Laurence Co., Inc. (CRL)**
Tel: (800) 421-6144 Fax: (800) 587-7501
Email: railings@crlaurence.com
www.crlaurence.com
- B. Manufacturers of equivalent products will be considered for substitution in accordance with provisions of Section 01 2500 - Product Substitution Procedures.

2.2 MATERIALS

- A. Aluminum Components: Conforming to ASTM B 221/ASTM B221M, Alloy 6063- T52
- B. Stainless Steel Components: Conforming to ASTM A 666, Type 304
- C. Brass Components: Conforming to ASTM B 248, No. 260, Yellow Brass

2.3 COMPONENTS

- A. Glazing: Fully tempered ASTM C 1048 Kind FT, Quality q3. As specified in Section 088000
 1. Monolithic Tempered Thickness: 1/2 inch (12 mm). (Architect to specify)

2. Color: Clear, or tint. (Architect to specify)
 3. Architect to specify edge type on exposed glass edges. (See section 08 8000.)
- B. Internal Handrail Cap Connection Sleeves: Metal tube, material compatible with handrail cap material.
- C. TAPER-LOC® Dry Glazing System: Each TAPER-LOC® Set consists of two Tapers, and one L-Setting Block. Designed for 8 B, B5A, B5S, B5T, B6S, and B7S Shoe Bases. Patent Pending.
- D. Shoe Base: (Architect to specify)
1. Profile: **CRL Part # 8B**; 2-1/2 inches (63.5 mm) wide by 4-1/4 inches (106.4 mm) high rectangular cross-section. Designed to work with CRL's TAPER-LOC® Dry Glazed System with 1/2" (12 mm) monolithic tempered glass.
 2. Material: Aluminum 6063-T52
 3. Finish: (Architect to specify.)
 - a. Base Cladding: Sheet metal cladding added to exposed shoe base sections. Adhere with double-sided tape and/or silicone adhesive. Provide end caps where ends of shoe base sections are exposed.
 - b. 304 Brushed Stainless (Architect to specify)
- E. Metal Cap Railing: (Architect to specify)
1. Profile: **Part # GR15**, round 1-1/2 inches (38.1 mm) diameter.
 2. Material: Stainless
 3. Finish: Brushed
- F. Handrail Brackets: (Architect to specify)
1. Material: Stainless Steel
 2. Fabrication: Machined
 3. Fabrication: Cast
 4. Finish: Match handrail cap finish
- G. Metal Handrail Tubing: (Architect to specify)
1. Profile: **Part # HR15**, round 1-1/2 inches (38.1 mm) diameter.
 2. Material: Stainless.
 3. Finish: Brushed
- H. Fasteners: Types and sizes indicated in shop drawings.
- A.** For concrete attachment, hole size in base shoe is to be 9/16" (14.3 mm), counter bore 7/8" (22.2 mm) x depth 1/2" (12.7 mm), center-to-center spacing of holes is 12" (304.8mm). Use Hilti HSL3 Expansion Anchors 3-3/4" (95 mm) long **CRL Part # EBA334**, Washer is included.
 - B.** For steel attachment, hole size in base shoe is to be 9/16" (14.3 mm), counter bore 7/8" (22.2 mm) x depth 1/2" (12.7 mm), center-to-center spacing of holes is 12"

(304.8mm). Use ½” – 13 x 1 stainless steel socket head cap screw **CRL Part # SHCS12X1**.

- I. Sill Angles for Tempered Glass Railing Assemblies: Steel angle profiles conforming to ASTM A 36, with anchoring devices, sizes indicated in shop drawing of section 05 5000, drilled and tapped for fastener types, sizes, and spacing indicated.

2.4 FABRICATION

- A. Fabricate handrail assembly components to lengths and configurations complying with shop drawings.
- B. Machine joint edges smooth and plane to produce hairline seams when site assembled; supply concealed sleeve connectors for joints.
- C. Isolate dissimilar metals to prevent electrolytic action by applying primer to concealed surfaces of metal components.

PART 3 INSTALLATION

3.1

- A. Install handrails in accordance with manufacturer’s recommended installation instructions and approved shop drawings.

3.2 CLEANING

- A. Clean glazing surfaces after installation, complying with requirements contained in the manufacturer’s instructions. Remove excess glazing sealant compounds, dirt or other substances.
- B. Remove protective films from metal surfaces.
- C. Clean railing surfaces with clean water and mild detergent. Do not use abrasive chemicals, detergents, or other implements that may mar or gouge the material.

3.3 PROTECTION

- A. Institute protective measures required throughout the remainder of the construction period to ensure that all the materials do not incur any damage or deterioration.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

- B. Repair components damaged by subsequent construction activities in accordance with manufacturer's recommendations; replace damaged components that cannot be repaired to Architect's acceptance.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOUCMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Wood blocking and nailers.
 - 3. Sheathing.
 - 4. Plywood backing panels.
 - 5. Blocking for toilet accessories.
 - 6. Composite insulated wall sheathing
- B. Related Sections include the following:
 - 1. Division 5 Section "Cold-Formed Metal Framing" for weather-resistant gypsum sheathing applied to cold-formed framing.
 - 2. Division 6 Section "Finish Carpentry" for finish plywood and nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association.
 - 2. NLGA - National Lumber Grades Authority.
 - 3. WCLIB - West Coast Lumber Inspection Bureau.
 - 4. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer for both treatment and fire-retardant formulation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dressed lumber, S4S, unless otherwise indicated.
 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2- inch nominal thickness or less, unless otherwise indicated.

- B. Wood Structural Panels:
 - 1. Plywood: DOC PS 1.
 - 2. Oriented Strand Board: DOC PS 2.
 - 3. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
 - 4. Factory mark panels according to indicated standard.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
 - 1. Preservative Chemicals: CA-B, Wolmanized Natural Select.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood nailers, blocking, stripping, and similar members in connection with flashing, air/vapor barriers, and waterproofing.
 - 2. Wood blocking, and similar concealed members in contact with concrete.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5516, for plywood.
 - 2. Use treatment that does not promote corrosion of metal fasteners.
 - 3. Use Interior TypeA High Temperature (HT), unless otherwise indicated.

2.5 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Framing, General: No. 2 grade and the following species: 1. Spruce-pine-fir; NLGA.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and the following species:
 - 1. Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
 - 1. Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.

2.7 SHEATHING

- A. Plywood Wall Sheathing: Exposure 1, Structural I sheathing.
 - 1. Span Rating: Not less than 32/16.
 - 2. 5/8" Plywood
 - 3. Species: Fir.

2.8 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.9 FASTENERS

- B. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, in roof area, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- C. Nails, Brads, and Staples: ASTM F 1667.
- D. Power-Driven Fasteners: CABO NER-272.
- E. Wood Screws: ASME B18.6.1.
- F. Screws for Fastening to Cold-Formed Metal Framing: Hilti Kwik-Flex or Elco Dril-Flex; no substitution, 10-24 x 1-1/4" wafer head #3.
- G. Lag Bolts: ASME B18.2.1.
- H. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

- I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. CABO NER-272 for power-driven fasteners.
 2. "Table2304.9.1--Fastening Schedule" of the 2003 International Building Code.
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
 1. Use hot-dip galvanized or stainless steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
 2. Use stainless steel fasteners when fastening preservative treated members.

3.2 WOOD SLEEPER BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Install wood blocking and nailers to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, casework, furnishings, or similar construction. Provide 3/4-inch thick plywood covering a minimum of 32 inches square for toilet accessories. Provide 1-1/2 inch thick blocking minimum for grab bars and handrail supports. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

- C. Roofing Nailers: Install wood nailers of same total thickness as insulation. Anchor perimeter nailers to substrate in a manner to resist a force of 75 pounds per linear foot in any direction. Top nailer shall be fastened through the lower layers and into deck.

3.3 WOOD FRAMING INSTALLATION, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install framing members of size and spacing indicated.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Anchor and nail as shown, and to comply with the following:
 - 1. National Evaluation Report No. NER-272 for pneumatic or mechanical driven staples, P-Nails, and allied fasteners.
 - 2. "Table2304.9.1--Fastening Schedule" of the 2003 International Building Code.
- F. Do not splice structural members between supports.
- G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.4 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Sheathing:
 - a. Screw to cold-formed metal framing.
 - b. Space panels 1/8 inch apart at edges and ends.
 - 2. Plywood Backing Panels: Screw to supports.

END OF SECTION 061000

SECTION 064000 - INTERIOR ARCHITECTURAL WOODWORK

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. Interior standing and running trim.
 - 2. Custom wood/plastic laminate casework.
 - 3. Custom plastic-laminate cabinets.
 - 4. Window sills and aprons.
 - 5. Shop finishing interior woodwork.
 - 6. Solid surface countertops.
 - 7. Shelving
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Division 6 Section "Finish Carpentry" for manufactured cabinets and interior carpentry exposed to view that is not specified in this Section.
 - 3. Division 9 Section "Painting" for field finishing of interior architectural standing and running trim receiving an opaque finish. Section 09770 Prefinished Interior Panels.
 - 4. Division 15 Sections for sink units mounted in countertops and for plumbing connections of appliances installed in casework.
 - 5. Division 16 Sections for conduit and connections installed in casework.
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Countertop supports furnished in Division 5 Section "Metal Fabrications."

1.03 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.
- B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.
- C. Semi exposed Surfaces of Casework: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers. Bottoms of wall cabinets are defined as "semi exposed."

- D. Concealed Surfaces of Casework: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of cabinets installed directly against and completely concealed by walls or other cabinets. Tops of wall cabinets and tall cabinets are defined as "concealed."

1.04 SUBMITTALS

- A. General: Submit in accordance with 01330.
- B. Product Data: For each type of product indicated, including cabinet hardware and accessories, and finishing materials and processes.
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in architectural woodwork and countertops.
- D. Samples for Verification: For the following:
 - 1. Lumber with transparent finish, 5-nches wide by 24-inches long, for each species and cut, finished on 1 side and 1 edge.
 - 2. Wood-veneer-faced panel products with or for transparent finish, 8-by 10-nches, for each species and cut. Include at least one face-veneer seam and finish as specified.
 - 3. Plastic-laminate-clad panel products, 8-by 10-nches, for each type, color, pattern, and surface finish.
 - 4. Stone with one edge finished to profile indicated, 6-nches square.
 - 5. Exposed cabinet hardware and accessories, one unit for each type and finish.
- E. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished and construction provided comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.
 - 1. Contract Documents contain selections chosen from options in the Quality Standards as well as additional requirements beyond those of the Quality Standards. Comply with such selections and requirements in addition to the Quality Standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and provisions have been made for maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by accurate field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.08 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: Maple, plain sawn and sliced.

- C. Wood Species for Opaque Finish: Any closed-grain hardwood.

- D. E. Wood Products: Comply with the following:
 - 1. Particleboard: ANSI A208.1, Grade M-2.
 - a. Provide water-resistant particleboard at within 2'-0" of sinks.
 - 2. Hardwood Plywood and Face Veneers: HPVA HP-1, 7-ply core, no voids, Grade A veneers.

- F. Thermoset Decorative Overlay (Melamine): Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1, fused to core using average pressure of 320 psi and average temperature of 320 deg F.

2.02 SHELVING

- A. Shelving for Storage Closets:
 - 1. Shelves: Thermoset decorative panels (melamine) on particleboard, ¾ inch thick minimum, with melamine edges on both faces and ends.
 - 2. Shelf Brackets and Standards: Twin slotted, heavy-duty, steel shelf standards and U-shaped, double prong, heavy-duty steel brackets, white powder coat finish.
 - a. Product: Standard No. E3200 and bracket No. E3210; Knape & Vogt Mfg. Co.

2.03 CABINET HARDWARE

- A. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

- B. Door and Drawer Pulls: Knobgallery: Amerock Pull Candler BP29355G10; finish: satin nickel.

- C. Shelf Rests: BHMA A156.9, B04013.
 - 1. Double pin shelf rest with clip retainer for 5 mm diameter drilled holes, PX Allen Fields.

- D. Drawer Slides: Side-mounted, full-extension, white epoxy-coated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf.
 - a. Product: Drawer slide No. 6200, Grasse, Inc. or No. 3211, Mepla-Alfit, Inc.
 - 2. File Drawer Slides: 200 lbf.
 - a. Product: Pendaflex No. 6110; Grasse, Inc. or Prosystem; Mepla-Alfit, Inc.

- E. Drawer Locks: Cylindrical type, 5-pin tumbler and cam, complying with BHMA A156.11, Grade 1; satin chrome finish.
 - 1. Provide minimum of 2 keys per lock.
 - 2. Lock all drawers; keyed according to Owner's instructions.

- F. Grommets for Cable Passage through Countertops: Molded-plastic grommets and matching plastic caps with slot for wire passage; size determined during Shop Drawing review; color

selected by Architect.

1. Manufacturers: Doug Mockett and Co., Inc. or Outwater Plastics, (800) 631-8375.

2.03 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Screws: Select material, type, size, and finish required for each use. Comply with ASME B 18.6.1 for applicable requirements.
- C. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
- D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- E. Glue: Aliphatic- or Phenolic resin wood glue recommended by manufacturer for general carpentry use. Comply with LEED low emitting materials - adhesives and sealants.

2.04 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated. When quality grade is not indicated, provide Custom quality grade.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members $\frac{3}{4}$ -inch Thick or Less: $\frac{1}{16}$ -inch.
 2. Edges of Rails and Similar Members More Than $\frac{3}{4}$ -Inch Thick: $\frac{1}{8}$ -inch.
 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: $\frac{1}{16}$ -inch.
- D. 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. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing

fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of water-resistant varnish.

2.05 CUSTOM INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Grade: Custom.
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- D. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- E. Wood Species and Cut: Maple, plain sawn.

2.06 CUSTOM INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Grade: Custom.
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- D. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- E. Wood Species: Any closed-grain hardwood.

2.07 WOOD/PLASTIC LAMINATE CASEWORK FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 400 requirements for wood and laminate cabinets.
- B. Grade: Custom.
- C. AWI Type of Cabinet Construction: Flush overlay.
- D. Wood Species and Cut for Exposed Surfaces: Maple, plain sawn or sliced.
 1. Grain Matching: Run and match grain vertically for drawer fronts and fixed panels.
 2. Matching of Veneer Leaves: Book match.
 3. Vertical Matching of Veneer Leaves: End match.
 4. Veneer Matching within Panel Face: Balance match.
 5. Drawer Faces: Solid wood.

- E. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: HGL.
 - 2. Vertical Surfaces: VGS.
 - 3. Edges: VGS.
 - 4. Colors, Patterns, and Finishes: As indicated by laminate manufacturer's designations in Interior Finish Legend for these characteristics.
- F. Semi exposed Surfaces: Provide surface materials indicated below:
 - 1. Drawer Sides and Backs: Thermoset decorative overlay.
 - 2. Drawer Bottoms: Thermoset decorative overlay.

2.08 PLASTIC-LAMINATE CASEWORK

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.
- B. Grade: Custom.
- C. AWI Type of Cabinet Construction: Flush overlay.
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: HGL.
 - 2. Vertical Surfaces: VGS.
 - 3. Edges: VGS.
- E. Colors, Patterns, and Finishes: As indicated by laminate manufacturer's designations in Interior Finish Legend for these characteristics.

2.09 SOLID SURFACE COUNTERTOPS

- A. General: Provide units with smooth surfaces in uniform plane free of defects.
- B. Solid Surface Fabrication: Provide units polished on all exposed surfaces, sawn on concealed surfaces, and having the following configurations:
 - 1. Nominal Thickness: Provide thickness indicated, but not less than indicated on the drawings. Gage backs to provide units of identical thickness.
 - 2. Edge Detail: As indicated.
 - 3. Seams: Fabricate tops without seams to the maximum extent possible. Where required, seams shall be hairline and sealant filled.
 - 4. Color: As indicated on finish legend.
 - 5. Provide integral solid surface sink.

2.10 WINDOW SILLS

- A. Quality Standards: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards."
- B. Window Sills (Stools) and Aprons for opaque finish: Fabricate to AWI Custom Grade, from solid hardwood, in profile indicated.

1. Species: Poplar.

2.11 ACCESSORY MATERIALS

- A. Counter Bracket Supports: Angle brackets fabricated of 1/8 inch steel with multiple 1/4-inch mounting holes on each leg; 3- by 3-inch, 45 deg notch at leg intersection for wire run clearance; 2,000 lb capacity; factory primed for field finishing.
 1. Size: Varies as required for condition; coordinate with Drawings.
 2. Product: Work Station Brackets; A & M Hardware, Inc.; phone: (888) 647-0200;

2.12 SHOP FINISHING

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
 1. Grade: Provide finishes of same grades as items to be finished.
- B. General: Priming and finishing of interior architectural woodwork required to be performed at fabrication shop are specified in this Section. Refer to Division 9 Section "Painting" for final finishing of installed architectural woodwork and for material and application requirements for woodwork not specified to receive final finish in this Section.
 1. Custom standing and running trim receiving an opaque finish shall be back primed for field finishing.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing Architectural woodwork, as applicable to each unit of work.
- D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
 1. Grade: Premium system for all casework grades .
 2. AWI Finish System TR-6: Catalyzed polyurethane.
 3. Staining: Match approved sample for color.
 4. Sheen: Satin, 30-50 gloss units.
 5. Provide 7 coat system on custom millwork indicated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming.

3.02 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of **1/8-inch** in **96-inches**.
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than **36-inches** long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 - 2. Install standing and running trim with no more variation from a straight line than **1/8-inch** in **96-inches**.
- F. Cabinets: Install without distortion so drawers fit openings properly and are accurately aligned. Adjust hardware to center drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than **1/8-inch** in **96-inch** sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops with no more than **1/8-inch** in **96-inch** sag, bow, or other variation from a straight line.
 - 2. Secure backsplashes to walls with adhesive.
 - 3. Install countertop brackets specified in Division 5 Section "Metal Fabrications." Painting of bracket specified in Division 9 Section "Painting."
 - 4. Provide cutouts for fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal surfaces of cutout edges.
 - 5. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- H. Solid Surface Tops: Install tops by adhering to supports with water-cleanable epoxy adhesive.
 - 1. Bond seams with stone seam adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to seams to prevent adhesive smears. Clamp units to temporary bracing to ensure that countertops are properly aligned and seams are minimum width.
 - 2. Apply sealant to seams and to gap between tops and wall; comply with Division 7 Section "Joint Sealants." Install per manufacturer's requirements.
- I. Refer to Division 9 Sections for final finishing of installed architectural woodwork.

3.03 SHELVING INSTALLATION

- A. Cut shelf cleats at ends of shelves about ½ inch less than width of shelves and sand exposed ends smooth.
- B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than 16 inches o.c. Use 2 fasteners at each framing member or fastener location for cleats 4 inches nominal in width and wider.
 - 1. Apply a bead of multipurpose construction adhesive to back of shelf cleats right before installing. Remove adhesive that is squeezed out immediately after fastening shelf cleats in place.
- C. Install standards for adjustable shelf brackets according to manufacturer's written instructions, space not more than 36 inches o.c. and within 6 inches of end of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- D. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.
 - 1. Fasten shelves to cleats with finish nails or trim screws, set flush.
 - 2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

3.04 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.04 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 064000

SECTION 070120 - BUILDING ENVELOPE AIR SEALING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Air sealing quality control.
 - 2. Air sealing testing.
 - a. Pressurized theatrical fog testing.
 - b. Compartmentalized blower door testing.
- B. Related Sections include the following:
 - 1. Division 1 Section "Construction Progress Documentation" for developing a schedule that includes tests and inspections.
 - 2. Division 7 Section "Building Insulation" for spray-applied foam insulation, foam-in-place sealant, air-vapor barrier box for ceiling electrical boxes, and sealing perimeter of steel door frames.
 - 3. Division 7 Section "Joint Sealants" for interior and exterior joint sealants.
 - 4. Division 8 Section "Steel Doors and Frames" for foam-in-place sealant around interior perimeter.
 - 5. Division 9 Section "Gypsum Board Assemblies" for sealing of gypsum board at interface with adjacent construction and with penetrations through gypsum board assemblies.

1.3 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Air Sealing Plan:
 - 1. Submit an Air Sealing Plan detailing the air sealing methods and materials and subcontractors to be used, the identity of the Air Sealing Representative, and an Air Sealing Schedule detailing both the air sealing work, as well as the anticipated timing of all the quality assurance testing.
- C. Submit air leakage test certification and compliance test reports.

1.4 QUALITY ASSURANCE

- A. Testing Agent: An independent agency with the experience and capability to conduct testing and inspecting indicated.

- B. Air Tightness Representative: The Contractor shall identify before the start of construction an assigned individual who is responsible for achieving the air tightness results. The air tightness representative shall be on site throughout the construction process, especially during framing, rough plumbing, heating, electrical and ventilation and drywall and shall be present during air leakage testing and air sealing. The air tightness representative shall submit an air-sealing sequencing plan before the start of construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 AIR SEALING LOCATIONS

- A. Rough Openings: Seal windows, doors, louvers, vents, outdoor air ducts, and any other penetrations in the exterior thermal envelop.
- B. Blind corners and cracks in the framing or exterior sheathing, including but not limited to joist pockets, structural framing, metal deck flutes, changes in materials, and louver blank-off panel.
- C. Foundation sills and joist headers between floors, cantilevered joists.
- D. Utility and Other Small Penetrations: Seal utility penetrations through exterior walls and ceilings with low-expansion polyurethane foam or acoustical sealant. Seal electrical ceiling boxes penetrating attic vapor barrier with air-vapor barrier box.
- E. Seal around wires, plumbing stacks, conduits and pipes that penetrate the top plate of interior and exterior walls, and penetrate attic vapor barrier with low-expansion polyurethane foam or acoustical sealant.
- F. Penetrations between area being tested for air leakage and adjoining interior spaces: Where partitions are fire rated, use sealants with appropriate fire ratings, otherwise use materials as noted above.

3.2 AIR TIGHTNESS TESTING

- A. Purpose: Quality assurance air tightness testing and whole-building air barrier compliance testing shall be for the purpose of identifying any areas that may not be adequately sealed. Testing will also assist in identifying those areas that do not need further sealing.
 - 1. Approach: Each component of the air barrier system shall be pre-tested during the construction at each building envelope milestone so as to avoid the necessity of removing or damaging subsequent installations by other trades. Perform quality assurance testing as specific assemblies are constructed, in order to quickly assess whether an acceptable standard of air sealing is being implemented.
 - 2. Quality Assurance Standard: Fog testing has no numerical standard and is therefore based on visual results and their interpretation. Satisfactory results are -when there is either no visible fog or at most very slight wisps of fog that are evident. Unsatisfactory

results are when streams of fog come pouring out of the building at inadequately sealed joints. Determination of whether a tested assembly passes the quality assurance testing will be made jointly by the independent testing subcontractor, a representative of the Owner, the Architect and the Air Tightness Representative of the General Contractor. Blower door testing and fog testing and the cost of bringing the building performance up to meet the standard shall be borne by the Contractor.

3. Timing of Quality Assurance Testing: All testing shall be performed as soon as the envelop and sealing systems are in place, and before any additional materials are installed that would prevent proper implementation of the quality assurance testing.
 - a. Assemblies to be initially tested shall include the following to permit evaluation of installation and corrective measures to be implemented for the remainder of the project:
 - 1) First instance of each wall assembly type with at least one window.
 - 2) First instance of a ceiling area.
 - 3) First instance of typical wall/roof/ceiling assembly joints.
 - b. Upon completion of initial testing and corrective measures, the remainder of the facility shall be tested as the project progresses, and shall be conducted as established in the air sealing plan.

B. Pressurized Theatrical Fog Testing: Standard Test method of identifying air leakage locations by fan pressurization and the introduction of theatrical fog:

1. Scope:
 - a. Test method describes a standardized technique for locating air-leakage through a building envelope under pressurization or de-pressurization. This test method consists of mechanical pressurization of building, building component, or building section and the introduction of visible fog into the pressurized space. Observations are made of any resulting leakage with an indoor to outdoor static pressure difference adequate to induce a visible flow through the reference hole and any air leakage sites. This test method is used to locate and seal significant air leakage.
 - b. Strong winds shall be avoided during testing.
 - c. Test method is intended to evaluate the air-tightness of a building envelope. Test method does not measure air leakage rates, but can be used to locate and eliminate air leakage.
 - d. This test method is intended for the evaluation of the air-tightness of building envelopes of single-zone buildings or by isolating components or sections of the building envelope. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the testing agent and contractor to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.
2. Terminology:
 - a. Definition of Terms Specific to this Standard:
 - 1) Theatrical Fog - A visible vapor generated by a fog generator, more commonly used in theatrical productions.
 - 2) Pressurization Fan - A blower door device that creates an induced pressure on one side of the building envelope boundary surface.
 - 3) Air-Leakage - An unintentional air movement across the building envelope.
 - a) Discussion - This movement includes flow through joints, cracks, and porous surfaces, or a combination thereof.

- 4) Building envelope - The boundary or barrier separating the interior volume of a building conditioned spaces from the outside environment.
 - 5) Single zone - A space in which the pressure differences between any two places, differ by no more than 4% of the inside to outside pressure difference.
 - 6) Blower door - A fan pressurization device incorporating a controllable fan and instruments for airflow measurement and building pressure difference measurement that mounts securely in a door or other opening.
 - 7) Building envelope pressure difference - The pressure difference across the test zone envelope (Pa, in. H₂O).
 - 8) Fan airflow rate - The volume of airflow through the blower door per unit of time (m³/s, ft³/min).
 - 9) Nominal airflow rate - The flow rate indicated by the blower door using the manufacturer's calibration coefficients (m³/s, ft³/min).
 - 10) Test pressure difference - The measured pressure difference across the building envelope, expressed in Pascals (Pa), (or in. of water or poundsforce/ft² or in. of mercury).
 - 11) Air tightness - The degree to which a test zone envelope resists the flow of air.
3. Apparatus:
- a. The following is a general description of the required apparatus: Any arrangement of equipment using the same principles and capable of performing the test procedure is permitted.
 - b. Major components:
 - 1) Air-Moving Equipment: Blower door assembly that is capable of moving air into and out of the enclosed space at the required flow rates. The system shall provide a pressure difference adequate to produce visible fog flow through the reference holes for the period required to identify and/or seal air leakage locations. Instrumentation shall be used to measure test pressure.
 - 2) Fog Generator: A device that produces a vapor that is visible in daylight or with artificial lighting (nighttime). The production rate shall be capable of maintaining a visible flow through the reference holes from the volume of the enclosed building envelope area that is being tested.
 - 3) Temporary Closures: Tarps, films, sheathing, or other materials necessary to enclose or isolate components or sections of the building envelope for pressurization.
4. Procedure:
- a. To create a single zone for this test procedure, all interconnecting doors in the conditioned space shall be opened such that a uniform pressure and a uniform distribution of fog will be maintained within the pressurized or de-pressurized space. Alternately, when creating an envelope on the outside of the building area to be tested, perform the test within each zone separately. Verify the uniformity of the pressure and fog distribution by confirming that the fog is flowing from all of the reference holes in the test area. Start the test when fog flow is observed at the lowest pressure that will be used in the test. Temporarily opening windows, doors, or other closures at the extremities of the test zone may aid in speeding the distribution of fog throughout the zone.
 - b. Place the fog generator inside the enclosed building envelope zone.
 - c. Make general observations of the condition of the building. Take notes on the conditions at the windows, doors, opaque walls, ceilings, roof and floor.

- d. Verify that the fog is observed at the reference holes at all times during the test. If the fog generator cannot keep up with the leakage rate, seal all observed leakage openings until the flow of fog is observed at all of the reference holes. Reference holes may be made in temporary enclosure rather than through the building envelope. Reference holes shall be located at the extremities of the testing envelope to ensure that fog is present over the entire area being tested.
 - e. Connect the air duct or blower door assembly to the building envelope, using a window, door, vent, or other opening in the temporary enclosure of building area being tested. Seal or tape these and other openings to avoid leakage at these points if required to maintain an adequate pressure to maintain enough pressure throughout the test area to assure fog flow at all reference holes.
 - f. Because specific building pressures are not required and the results of the test is not quantitative, leakage between the test zone and other sections of the building envelope not being tested are allowed as long as the pressure and fog production are adequate to assure the flow of fog from all of the reference holes. Maintain the test pressure at or below 20 Pa relative to the outdoors to reasonably model actual building operating pressures.
 - g. Locating Reference Holes: Use more than one reference hole location across the building envelope area to be tested; example one on each façade. Drill the reference holes in the center at the extremities of the test area. Locations shall include holes at the highest and lowest level on the windward and leeward sides of the building envelope or test area. Buildings more than three stories, or 25.5 f), may require multiple tests at more than one height on the exterior envelope to verify adequate pressures throughout the test area.
 - h. Size of Reference Hole(s): The reference hole is designed to verify that the pressure and fog level in the pressurized or depressurized space is adequate to locate any open penetrations in the building envelope area being tested. A 1/4-inch diameter hole shall be drilled through the envelope materials in the required locations. For construction with thick wall materials or cavity walls, a 1/8-inch inside diameter tube shall be installed through the entire wall thickness to verify that the test conditions are met at the reference hole locations.
 - i. The range of the induced pressure difference shall be not less than 10 Pa (0.04 in. H₂O). Verify that the far end of the building or section of building being tested has reached the desired compliance test pressure using the ASTM E779 test method..
 - j. Localized test can be performed using this test method by "washing" the selected surface with fog. This method requires reference holes in the zone being tested in a pattern frequent enough to verify that the building pressure and fog density is adequate to locate any leakage sites, typically a minimum of 4' O.C. both vertically and horizontally.
5. Report:
- a. Report the following information:
 - 1) Building description, including location (street, city, state/province, zip or postal code, and country).
 - 2) Type of building construction and penetrations.
 - 3) Condition of openings in building envelope including:
 - a) Doors, windows, ventilation openings, dampers, chimneys closed or not installed.

- b) Statement whether the test zone is interconnected with other sections of the building and how the openings are closed.
- 4) Statement of whether the test zone is enclosed on the inside or outside.
- b. Procedures, including the test equipment used (manufacturer, model, S/N).
- c. Measurement data, including:
 - 1) Fan pressurization measurement (inside-outside) required to generate fog flow at the reference holes, if recorded.
 - 2) Reference-hole size, type and location.
 - 3) Wind speed/direction and whether wind speed is estimated to exceed 0 to 2 m/s (0 to 4 mph).
 - 4) Locations of air leakage noted and/or sealed.

3.3 BLOWER DOOR TESTING

- A. Blower door testing shall be performed in accordance with ASTM E779, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
- B. The building shall achieve a maximum air leakage of 0.40 cfm50/sq.ft.of external, above grade building shell surface area (not including basement walls).
- C. When calculating surface area for meeting the maximum air leakage ratio, the surface areas adjoining other interior spaces shall be included as part of the exterior wall, as these partitions should be air tight for purposes of maintaining acoustic and/or fire ratings.
- D. Prepare test reports for each area of the building tested in accordance with ASTM E779. Test results shall be approved in writing by the Architect for each test location before the work is concealed and made inaccessible.

END OF SECTION 070120

SECTION 071000 - CEMENTITIOUS WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes cementitious waterproofing for elevator pits.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-In-Place Concrete."

1.3 SUBMITTALS

- A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
- B. Product Data: For each type of product indicated, including installation instructions.
- C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced waterproofing Applicator.
- B. Source Limitations: Obtain cementitious waterproofing materials through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials and equipment in a single area of project site. Provide adequate means to protect floors and adjacent surfaces of this area from damage.

1.6 PROJECT CONDITIONS

- A. Weather Limitations: Do not apply waterproofing when effects of freezing or moisture will adversely affect the waterproofing application.
- B. Maintain adequate ventilation during preparation and application of cementitious waterproofing materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cementitious Waterproofing: "Five Star Waterproofing" trowel applied negative side cementitious membrane and mixing liquid system manufactured by Five Star Products, Inc., or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
 - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 2. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 3. Application of coating to surfaces shall constitute acceptance of surfaces and conditions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surfaces must be clean. Chip or grind off all defective materials and foreign matter. Remove form treatment residue, curing compound, scum and fungus.
- B. Repair cracks, breaks, honeycombing, or other surface imperfections with non-expansive patching mortar to attain a finish comparable to adjacent concrete surfaces.

3.3 INSTALLATION

- A. Cementitious Waterproofing:
 - 1. Apply cementitious waterproofing treatment to the floor and walls of elevator pit to a minimum thickness of 1/8-inch after elevator jack hole has been poured around with cast-in-place concrete.
 - 2. Trowel all surfaces to a smooth, hard finish, free from pits hollows and other defects.
 - 3. Provide 1-inch by 1-inch cant at intersection of horizontal and vertical surfaces.
 - 4. Apply in strict accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Protect waterproofing from damage by other trades after installation to maintain the integrity of the waterproofing.

END OF SECTION 071000

SECTION 071113- BITUMINOUS DAMP PROOFING

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.

1.02 SUMMARY

- A. This Section includes the following:
 - a. Cold-applied asphalt emulsion damp-roofing.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 013000.
 - 1. Product Data: Include data substantiating that materials comply with specified requirements or each damp proofing material specified.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced dampproofing installer who has completed bituminous dampproofing work similar in material, design, and extent to that indicated for Project and that has resulted in construction with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain primary dampproofing materials and primers from a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

1.05 PROJECT CONDITIONS

- A. Substrate: Proceed with dampproofing work only after substrate construction and penetrating work have been completed.
- B. Weather: Proceed with dampproofing work only when existing and forecast weather conditions will permit work to be performed in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 COLD-APPLIED ASPHALT EMULSION DAMPPROOFING

- A. Asphalt Emulsion: Asphalt-and-water-emulsion coating, compounded to penetrate substrate and build to moisture-resistant coating.
 - 1. Provide semi-fibrated-type semi mastic asbestos free emulsion; ASTM D 127. Type II except containing non asbestos fibrous reinforcement and filler materials.

- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering asphalt emulsion products that may be incorporated in the work include, but are not limited to, the following:
1. Celotex Corporation.
 2. Karnak Chemical Corporation.
 3. Koch Materials Company.
 4. Koppers Company, Inc.
 5. Manville Building Materials Corporation.

PART 3 - EXECUTION

3.01 PREPARATION OF SUBSTRATE

- A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.
- B. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.
- C. Fill voids, seal joints, and apply bond breakers (if any) as recommended by prime materials manufacturer, with particular attention at construction joints.
- D. Install separate flashings and corner protection stripping as recommended by prime materials manufacturer, where indicated to proceed with application of dampproofing. Comply with details shown and manufacturer's recommendations. Give particular attention to requirements at building expansion joints, if any.
- E. Prime substrate as recommended by prime materials manufacturer.
- F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.02 INSTALLATION, GENERAL

- A. Comply with manufacturer's recommendations, except where more stringent requirements are indicated or specified and where project conditions replace extra precautions or provisions to ensure satisfactory performance of work.
- B. Bituminous Cant Strips: Install **2-inch by 2-inch** cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.
- C. Extend vertical dampproofing down walls from finished grade line to top footing, extend over top of footing, and turn down minimum of **6-inches** over outside face of footing. Extend **12-inches** onto intersecting walls and footings but do not extend onto surfaces that will be exposed to view when project is completed.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

- D. Apply coat of semi fibrated, semi mastic, asphalt emulsion dampproofing materials by brushing or spraying at rate of 5.0 gallons per 100 sq. ft. to product uniform, dry film thickness of not less than 30 mils.

END OF SECTION

SECTION 072100 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Foundation insulation.
 - 2. Concealed building insulation.
 - 3. Foam-in-place insulation.
 - 4. Steel door frame insulation.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry Assemblies" for insulation installed in cavity walls and masonry cells.
 - 2. Division 6 Section 061000 for Polyiso Insulated Panels.
 - 3. Division 7 Section "Fluid-Applied Air/Vapor Barrier System."
 - 4. Division 7 Section Thermo Plastic Membrane Roofing for insulation specified as part of roofing construction.
 - 5. Division 9 Section "Gypsum Board Assemblies" for provision in metal-framed assemblies of interior acoustical insulation.
 - 6. Division 22/23 Sections for insulation on ducts, piping, and equipment.

1.3 DEFINITIONS

- A. Thermal Resistivity: Where the thermal resistivity of insulation products are designated by "r-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test- response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 COORDINATION

- A. Coordinate installation of insulation with installation of air/vapor barrier system.
- B. Complete installation of exterior insulation prior to heating building interior.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 - 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

- B. Foundation and Under Slab Insulation: Extruded-polystyrene board insulation, ASTM C 578, Type IV, 1.60 lb./cu. ft., unless otherwise indicated, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
 - 1. Thickness: 2 inches, unless indicated otherwise.
 - 2. Edge Treatment: Tongue and groove or shiplap edges.
 - 3. Products:
 - a. Styrofoam; Dow Chemical Company.
 - b. Foamular 250; Owens Corning.
 - c. Amofoam; Tenneco Building Products.
- C. Rigid Insulation: Extruded-polystyrene board insulation, ASTM C 578, Type IV; 25.0 psi minimum compressive strength; 1.60 lb./cu. ft., unless otherwise indicated, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
 - 1. Thickness: 1, 2 and 3 inches, as indicated.
 - 2. Edge Treatment: Tongue and groove or shiplap edges.
 - 3. Products:
 - a. Styrofoam; Dow Chemical Company.
 - b. Foamular 250; Owens Corning.
 - c. Amofoam; Tenneco Building Products.
- D. Foam-In-Place Insulation: On-site foam-in-place insulation shall be Froth-Pac 1.75-25 FS Class 1 foam manufactured by Insta-Foam Products, Inc., or approved equal.
- E. Sound Attenuation Blankets (Acoustical Insulation): See Division 9 Section "Gypsum Board Assemblies."

2.3 INSULATION FASTENERS

- A. Insulation Fastener with Locking Plate: Factory-coated steel fasteners and 3-inch diameter plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening insulation through gypsum sheathing and into cold-formed metal framing not less than 3/4-inch.
 - 1. Product: OMG ASAP 3P; OMG Roofing Products, Agawam, MA 01001; phone: (800) 633-3800.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
 - 1. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OFFOUNDATION AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. Extend insulation to top of footing, unless indicated otherwise.
- B. Protect top surface of horizontal insulation from damage during concrete work by applying protection board. Refer to drawings for locations-sizes

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Fill voids in thermal envelope not covered by the work of other sections.
- B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Fasten rigid board insulation over air/vapor barrier applied to weather-resistant gypsum sheathing using insulation fastener with locking plate. Threads of screws shall penetrate through the insulation and gypsum sheathing into cold-formed metal framing not less than 3/4- inch. Fastener must be tight enough to prevent the plate fromturning, but shall not be overdriven causing the skin of insulation board to fracture.
 - 1. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

3.6 INSTALLATION OF FOAM-IN-PLACE INSULATION

- A. Install foam-in-place insulation sealant to a minimum depth of 1 inch, sealing deck flutes and construction cracks and gaps where outside air and cold can infiltrate, providing an airtight building envelope.
- B. Install foam-in-place insulation in upper portion of stud cavity to provide continuous thermal barrier between roof insulation and insulation outboard of building sheathing.

3.7 INSULATING STEEL DOOR FRAMES

- A. Exterior Frames: Steel door frames in exterior walls shall be filled with rigid insulation. Cut rigid insulation slab the full width of frame throat and insert continuous slab into door frame head and jambs before frame is installed. After frame is installed, fill remaining gap between rigid insulation and air/vapor barrier with foam-in-place insulation.

3.8 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072110 - SPRAY-IN-PLACE RIGID URETHANE FOAM INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes spray polyurethane foam insulation.
- B. Related Sections include the following:
 - 1. Division 07 Section "Building Insulation" for foam-plastic board insulation and miscellaneous foam sealant.

1.3 SUBMITTALS

- A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
- B. Product Data: For each type of product indicated.
 - 1. Submit catalyst and temperature requirements for its use.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
- C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.
- D. Qualification Data: For Installer signed by manufacturer certifying that Installers comply with requirements. Submit list of similar type projects along with the Architect and Owner contact information for each project.
- E. Report of Framing and Sheathing Temperatures: Submit report of framing and sheathing temperatures taken prior to application of spray polyurethane foam insulation.
- F. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Shall be approved in writing by spray polyurethane foam insulation manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers with labels indicating manufacturer, product name and designation, and directions for storing and mixing with components.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other

causes. Store materials covered, out of direct sunlight, and at temperatures between 60 deg F and 70 deg F.

- C. Dispose of empty containers by technicians in accordance with manufacturer's recommendations, current law, and industry standard practice.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply material when ambient or substrate temperature is 45 deg F or lower for 72 hours before, during, and for 24 hours after product application. Do not apply material when moisture due to dew, frost or water is present on substrate materials.

PART 2 - PRODUCTS

2.1 SPRAY POLYURETHANE FOAM (SPF) INSULATION

- A. Closed-Cell Polyurethane Foam Insulation (SPF): ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84; with non-ozone depleting blowing agent. Coordinate catalysis with application temperature conditions.
 1. Density: ASTM D 1622; minimum density of 2.0 lb/cu. ft.
 2. Thermal Resistivity (R-Factor), LTTR: Not less than 6.4 per inch of thickness.
 3. Closed Cell Content: ASTM D 2856, 90 percent minimum.
 4. Vapor Permeance: ASTM E 96, 1-inch thickness, 1.2 perms maximum.
 5. Fungi Resistance: ASTM C 1338, no growth.
 6. Applied Thickness: Apply to provide a cured thickness as indicated. Where thickness is not indicated, provide a cured thickness of not less than 3 inches and not more than 4 inches.
 7. Products:
 - a. JM Corbond III SPF; Johns Manville Corporation.
 - b. CertaSpray Closed Cell Foam; CertainTeed Corporation.
 - c. Heatlok Soy; Demilec LLC, Arlington, TX.
 - d. Permax 2.0; Henry Company.
 - e. Icynene MD-C-200; Icynene, Inc.
 - f. Styrofoam SPF RS Series; Dow.
 - g. Or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Mask and cover windows, doors, electrical boxes, and other items not indicated to receive insulation, protecting from fallout or overspray of materials during application.
- B. Brush down framing, interior face of exterior sheathing, and adjacent substrates to loosen and remove cobwebs, dirt, dust and debris. Upon completion of operations, substrate shall be clean of substances that are harmful to insulation or that interfere with insulation attachment.
- C. Maintain a minimum ambient and substrate temperature of 45 deg F for 72 hours prior to application of spray polyurethane foam insulation.

- D. Substrate Conditions: Using a thermal scan, verify that the temperature of the framing and sheathing substrates is 45 deg F or above. Record locations and temperatures of thermal readings. Do not apply insulation until substrates are at specified temperatures.

3.2 INSTALLATION OF SPRAY POLYURETHANE FOAM INSULATION

- A. Coordination: Coordinate installation with sequence of construction to permit application of spray-applied insulation to location made inaccessible by enclosed construction.
- B. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Spray insulation to envelop entire area to be insulated and fill voids. Apply in consecutive passes as recommended by the manufacturer to achieve specified thickness.
 - 1. To prevent foam shrinkage and separation from exterior framing members, verify that proper catalyst is being used for temperature conditions. Maintain two part foam components at proper temperature in canisters and hose to nozzle tip.
 - 2. Apply foam at proper rate and thickness to assure foam does not overheat during curing.

3.3 CLEANING

- A. Cleaning: Remove material overspray, and protection materials from surfaces of other construction and clean exposed surfaces. Remove trash and debris from the project site and properly dispose of.

END OF SECTION 072110

SECTION 072630 - Vapor Permeable Air Barrier System

PART 1: GENERAL

1.1 SECTION INCLUDES

- A. Materials and installation methods for a liquid applied vapor permeable air barrier system located in the cavity wall.
- B. Materials and installation to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier.
 - 2. Connections of the walls to the foundation.
 - 3. Seismic and expansion joints.
 - 4. Openings and penetrations of window frames, store front, curtain wall.
 - 5. Barrier precast and other envelope systems.
 - 6. Door frames.
 - 7. Piping, conduit, duct and similar penetrations.
 - 8. Masonry ties, screws, bolts and similar penetrations.

1.02 RELATED SECTIONS

- A. 033000 – Cast-In-Place Concrete
- B. 042000 – Masonry Units
- C. 077200 – Roof Accessories
- D. 077616 – Porcelain roof Pavers
- E. 079200 – Sealants
- F. 081000 – Door Frames
- G. 089110 – Glazed Aluminum Curtain Walls
- H. 092300 – Gypsum Sheathing

1.3 REFERENCES

- A. ASTM D412: Tensile Strength and Elongation
- B. ASTM E96 (Method B): Water Vapor Permeance (perms)
- C. ASTM 2178: Air Permeance of Building Materials

1.04 SUBMITTALS

- A. Submit manufacturer's product data sheets, application guidelines, detailed drawings and samples prior to commencing the work.

1.5 QUALITY ASSURANCE

- A. The air barrier contractor shall be trained and certified by the manufacturer. Installation shall be performed in accordance to the manufacturer's guidelines.
- B. Obtain air barrier components from a single manufacturer if possible.
- C. Provide products which comply with all state and local regulations controlling the use of volatile organic compounds (VOC's).

1.6 DELIVERY, STORAGE and HANDLING

- A. Deliver materials to project site in original packages with seals unbroken and labeled by the manufacturer.
- B. Store materials above 40° F.

1.7 PROJECT CONDITIONS

- A. Apply air barrier within range of ambient substrate temperatures recommended by manufacturer. Do not apply air barrier to a damp or wet substrate, unless permitted by the manufacturer.
- B. Do not apply air barrier in snow, rain fog or mist.

PART 2: PRODUCTS

2.01 MANUFACTURER

- A. Rubber Polymer Company, LLC 5760 County Line Rd, Cumming, GA 30040 (770) 410-1545, Fax (770) 410-1347, www.rpcinfo.com.

2.2 MATERIALS

- A. Single component, liquid applied vapor permeable air barrier membrane, VOC compliant:
 - 1. Rub-R-Wall Airtight VP by RPC having an Air Leakage Rating (ASTM E2178) less than 0.004 cfm/ft², Water Vapor

Permeance (ASTM E96) 12 perms and Elongation > 1,000 %.

2.3 AUXILIARY MATERIALS

- A. Transition Strip: Self adhering membrane having a thickness of 40 mils. 1. Rub-R-Wall SA by RPC.
- B. Primer: Rub-R-Wall SA Primer by RPC.
- C. Concrete Repair: Rub-R-Wall Mastic by RPC.

PART 3: EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas and conditions under which vapor permeable air barrier system will be installed. Verify that surfaces and conditions are suitable prior too commencing work of this section. Do not proceed until unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare and treat substrate according to manufacturer's written instructions. Provide clean, dust-free and dry substrate for air barrier application.
- B. Patch all voids and holes with mastic.
- C. Ensure all joints (exterior sheathing) are taped with a 2" minimum mesh tape recommended by manufacturer.

3.3 INSTALLATION

- A. Transition joints: Seal with transition strip at beams, columns, changes in substrate materials, and similar joints or connections to provide continuity of air barrier assembly. Apply transition strips so that a minimum of 3" coverage is achieved over both substrates. Position strip over firm bearing to window frame perimeter and door frames. Lap transition strip from wall substrate with 3" of full contact over firm bearing to window or door frame with 1" of full contact.
- B. Spray apply material at a coverage rate of 25 to 30 ft²/gal providing a thickness of 60 to 80 mils in two coats.
- C. Inspect surface area with wet mil gauge to ensure proper thickness.
- D. Allow 24 hours for membrane to fully cure.

SECTION 07415 - COMPOSITE WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following:
 - 1. Metal-faced composite wall panels and soffits.
 - 2. Backup strips for panel attachments.
 - 3. Panel attachment system including all anchorages, shims and fasteners.
 - 4. Sealant for panel joints and panel to adjacent construction materials.
- B. Related Sections:
 - 1. Division 5 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal-faced composite wall panels.
 - 2. Division 7 Section "Insulated-Core Metal Wall Panels" for foamed-insulation core metal wall panels.
 - 3. Division 7 Section "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of metal-faced composite wall panel assemblies.
 - 4. Division 7 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITION

- A. Metal-Faced Composite Wall Panel Assembly: Metal-faced composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal-faced composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design metal-faced composite wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Water Penetration Under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..

- D. Structural Performance: Provide metal-faced composite wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure as indicated on Drawings.
 2. Deflection Limits: Metal-faced composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span at the perimeter and 1/60 of the span anywhere in the panel.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 2. Fabrication, assembly, and erection procedures shall take into account ambient temperature range at time of perspective operation.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal-faced composite wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal-faced composite wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.
1. Accessories: Include details of the following items, at a scale of not less than 3 inches per 12 inches:
 - a. Flashing and trim.
 - b. Anchorage systems.
- C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Metal-Faced Composite Wall Panels: Minimum 12 x 12 inches. Include fasteners, closures, and other metal-faced composite wall panel accessories.
 - a. Composite Panels: Include four-way joint.
 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 3. Accessories: 12-inch- long Samples for each type of accessory.
 4. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of metal-faced composite wall panels adjacent to joint sealants.
- D. Delegated-Design Submittal: For metal-faced composite wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Maintenance Data: For metal wall panels to include in maintenance manuals.

F. Warranties: Samples of special warranties.

1.6 QUALITY ASSURANCE

A. Fabricator/Installer Qualification: Shall be certified by metal-faced composite wall panel manufacturer to fabricate and install manufacturer's wall panel system and employing workers trained and approved by manufacturer.

1. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer based on testing and engineering analysis of manufacturer's standard units indicated for this Project.

B. Source Limitations: Obtain each type of metal-faced composite wall panel from single source from single manufacturer.

C. Fire-Resistance Ratings: Where indicated, provide metal-faced composite wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

D. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, metal-faced composite wall panel Installer, metal-faced composite wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal-faced composite wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal-faced composite wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal-faced composite wall panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal-faced composite wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal-faced composite wall panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal-faced composite wall panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite wall panels for protection during transportation and handling.

- B. Unload, store, and erect metal-faced composite wall panels in a manner to prevent bending, warping, twisting, and surface damage. Cover fork truck tines and use protected rigging lifting devices to protect panels from marring and damage.
- C. Store metal-faced composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F. Protect strippable protective covering on metal wall panels from exposure to sunlight and high humidity.
- D. Retain strippable protective covering on metal-faced composite wall panel for period of panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite wall panels to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal-faced composite wall panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate metal-faced composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-faced composite wall panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal-faced composite wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

- b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, **ASTM B 209**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
- 1. Surface: Smooth, flat finish.
 - 2. Exposed Coil-Coated Finishes:
 - a. FEVE Fluoropolymer: AAMA 620. 2-coat fluoropolymer finish containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil**.
- B. Panel Sealants:
- 1. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal-faced composite wall panels and remain weathertight; and as recommended in writing by panel manufacturer.
 - a. Sealants shall match adjacent panel color.
 - 2. Plastic Foam Joint Fillers (Backer Rods): Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - a. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

2.2 MISCELLANEOUS MATERIALS

- A. Aluminum Extrusions: **ASTM B221**, alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Backup Strips: Continuous strips of metal-faced composite wall panel material, 4 mm thick. Provide minimum 4-inch wide strips at horizontal joints and 18 inch wide strips at vertical joints.
- C. Vent Screen: Insect screen fabricated from extruded high-density polyethylene (HDPE) allowing air movement and preventing insect intrusion.
- D. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide

exposed fasteners with heads matching color of metal-faced composite wall panels by means of plastic caps or factory- applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.3 METAL-FACED COMPOSITE WALL PANELS

- A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
 - 1. Fire-Retardant Core: Noncombustible, with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alcan Composites USA Inc.; Alucobond.
 - b. Alcoa Inc.; Reynobond PE.
 - c. ALPOLIC, Division of Mitsubishi Chemical America, Inc.; ALPOLIC.
- B. Aluminum-Faced Composite Wall Panels, ACM: Formed with **0.020-inch** thick, coil-coated aluminum sheet facings.
 - 1. Panel Thickness: **0.157 inch**.
 - 2. Core: Standard.
 - 3. Exterior Finish: FEVE fluoropolymer .
 - a. Color: refer Exterior Elevations
- C. System Type: Rear-ventilated, wet seal route and return system. The system shall allow the removal of individual panels.
- D. Attachment System Components: Formed from extruded aluminum.
 - 1. Include manufacturer's standard panel clips and anchor system.

2.4 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.
- B. Flashing and Trim: Fabricate from 0.032 inch minimum thickness aluminum sheet with same finish, and color as facings of adjacent composite panels, unless otherwise indicated. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels.

- C. Round Vents: Aluminum vents, 2 inch diameter, insect screening; finish to match composite wall panel.
 - 1. Product: Mini Louver, Air Vent Inc.

2.5 FABRICATION

- A. General: Fabricate and finish metal-faced composite wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal-faced composite wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Metal-Faced Composite Wall Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
 - 1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
 - 2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
 - 3. Dimensional Tolerances:
 - a. Panel Bow: 0.8 percent maximum of panel length or width.
 - b. Squareness: 0.25 inch maximum.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
 - 3. Fabricate flashing and trim in 8 to 10 foot lengths.
 - 4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall panel manufacturer for application, but not less than thickness of metal being secured.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that studs and other structural panel support members and anchorage have been installed within alignment tolerances required by metal-faced composite wall panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal-faced composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.
- C. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Backup Strip Installation: Install backup strips at joints in metal-faced composite wall panel system. The backup strips in the horizontal direction shall be continuous and in the vertical direction shall be spaced as needed.

3.3 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

- A. General: Install metal-faced composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting of metal wall panels by torch is not permitted.
 - 2. Shim or otherwise plumb substrates receiving metal-faced composite wall panels.
 - 3. Flash and seal metal-faced composite wall panels at perimeter of all openings. Do not begin installation until air/vapor barrier membrane and flashings that will be concealed by panels are installed.
 - 4. Install flashing and trim as metal-faced composite wall panel work proceeds.

5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal-faced composite wall panel assemblies. Provide types of fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
1. Prepare joints and apply sealants to comply with installation requirements in Division 7 Section "Joint Sealants."
- E. Attachment System Installation, General: Install attachment system required to support metal- faced composite wall panels and to provide a complete weathertight wall system, including perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
 2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.
- F. Rear Ventilated, Wet Sealed, Route and Return System Installation: Attach panel clips to supports at each metal-faced composite wall panel joint at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners. Hold returned flanges of wall panels off backup strips 1/4-inch to provide a continuous air flow gap the entire height of the wall.
1. At top and bottom of wall system and at heads and sills of doors, windows, louvers and other interruptions of vertical air flow gap, install insect screen to completely fill space between back of metal-faced composite wall panel and face of rigid insulation.
 2. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to installation requirements specified in Division 7 Section "Joint Sealants."

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal-faced composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, approved Shop Drawings, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet** with no joints allowed within **24 inches** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with mastic sealant (concealed within joints).
 3. Exposed fasteners shall match color and finish of material being secured.
- C. Vents: Install in accordance with manufacturer's instructions at spacing indicated.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal-faced composite wall panel units within installed tolerance of **1/4 inch in 20 feet**, nonaccumulative, on level, plumb, and location lines as indicated and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal-faced composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.
- B. After metal-faced composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal-faced composite wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
1. Repair metal-faced composite panels with minor damage so that repairs are not discernible at a distance of 5 feet when within 8'-0" of grade and not discernible at a distance of 10 feet when more than 8'-0" above grade.

END OF SECTION 07415



Architectural Block Three-Part Specification

07 42 43

Composite Wall Panels

Part I - General

1.1 SECTION INCLUDES:

- A. Exterior, panelized fiber cement cladding system and accessories to complete a drained and back-ventilated rainscreen.
- B. Interior fiber cement panelized cladding system and accessories.

1.2 RELATED SECTIONS

- A. Section 05 41 00 - Structural Metal Stud Framing
- B. Section 06 10 00 - Rough Carpentry
- C. Section 06 16 00 - Sheathing
- D. Section 07 20 00 - Thermal Protection
- E. Section 07 25 00 - Weather Barriers
- F. Section 07 60 00 - Flashing and Sheet Metal
- G. Section 07 90 00 - Joint Protection

1.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 509-09 – Voluntary Test and Classification Method of Drained and Back Ventilated Rain Screen Wall Cladding Systems
- B. ASTM International (ASTM):
 - 1. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 2. ASTM C 1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber Cement.
 - a. ASTM C 1186 – Standard Specification for Flat Fiber-Cement Sheets.
 - 3. ASTM E-84 - Standard Test for Surface Burning Characteristics of Building Materials.
 - 4. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

5. ASTM E 228 - Standard Test Method for Linear Thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer.
 6. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 7. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 8. ASTM G 23 - Standard Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) with and without Water for Exposure of Nonmetallic Materials, Replaced by G152 and G153.
- C. Florida Building Code - Test Protocol HVHZ
1. Testing Application Standard (TAS) 201, 202, 203 – Impact Test Procedures
- D. National Fire Protection Association (NFPA):
1. NFPA 285 - Fire Test Method for Exterior Wall Assemblies Containing Combustible Material.
 2. NFPA 268 – Ignition Resistance of Exterior Wall Assemblies.
- E. Standards Council of Canada & Underwriters Laboratories Canada (ULC):
1. CAN/ULC S-102 – Standard Method of Test for Surface Burning Characteristics.
 2. CAN/ULC S-134 – Standard Method of Fire Test of Exterior Wall Assembly.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Submit manufacturer's product description, storage and handling requirements, and installation instructions.
- C. Product Test Reports and Code Compliance: Documents demonstrating product compliance with local building code, such as test reports or Evaluation Reports from qualified, independent testing agencies.
- D. LEED Credits: Provide documentation of LEED Credits for project certification under USGBC LEED 2009 (Version 3.0) or 2012 v.4.
- E. Manufacturer's Details: Submit drawings (.dwg, .rvt, and/or .pdf formats), including plans, sections, showing installation details that demonstrate product dimensions, edge/termination conditions/treatments, compression and control joints, corners, openings, and penetrations.
- F. Samples: Submit samples of each product type proposed for use.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. All fiber cement panels specified in this section must be supplied by a manufacturer with a minimum of 10 years of experience in fabricating and supplying fiber cement cladding systems.

a. Products covered under this section are to be manufactured in an ISO 9001 certified facility.

2. Provide technical and design support as needed regarding installation requirements and warranty compliance provisions.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer trained by manufacturer or representative.

C. Mock-Up Wall: Provide a mock-up wall as evaluation tool for product and installation workmanship.

D. Pre-Installation Meetings: Prior to beginning installation, conduct conference to verify and discuss substrate conditions, manufacturer's installation instructions and warranty requirements, and project requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Panels must be stored flat and kept dry before installation. A waterproof cover over panels and accessories should be used at all times prior to installation.

B. If panels are exposed to water or water vapor prior to installation, allow to completely dry before installing. Failure to do so may result in panel shrinkage at ship lap joints, and such action may void warranty.

C. Panels **MUST** be carried on edge. Do not carry or lift panels flat. Improper handling may cause cracking or panel damage.

D. Direct contact between the panels and the ground should be avoided at all times. It is necessary to keep panels clean during installation process.

1.7 WARRANTY

A. Provide manufacturer's 15-year warranty against manufactured defects in fiber cement panels. Additional 5-year extension available when refinished in year 14-15.

B. Provide manufacturer's 15-year warranty against manufactured defects in panel finish.

C. Warranty provides for the original purchaser. See warranty for detailed information on terms, conditions and limitations.

PART II: PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Nichiha Corporation, 18-19 Nishiki 2-chome Naka-ku, Nagoya, Aichi 460-8610, Japan.

B. Acceptable Manufacturer's Representative: Nichiha USA, Inc., 6465 E. Johns Crossing, Suite 250, Johns Creek, GA 30097. Toll free: 1.866.424.4421, Office: 770.805.9466, Fax: 770.805.9467, www.nichiha.com.

1. Basis of Design Product: Nichiha Architectural Block.

a. Profile colors: Gray, Mocha, Tuscan.

b. Profiles: Large (without score line) or Small (with added score line).

c. Accessory/Component Options:

i. Manufactured Corners with 3-1/2" returns for each profile color.

ii. Aluminum trim to be painted per finish schedule: Outside corners (Corner Key, Open Outside Corner), vertical joints (H-Mold), terminations (J-Mold)

iii. Essential Flashing System: Starter, Compression Joint, Overhang.

d. Dimensions – AWP-1818: 455mm (17-7/8") (h) x 1,818 mm (71-9/16") (l).

e. Panel Thickness: 16 mm (5/8").

f. Finish: Matte, lightly textured.

g. Weight: 35.27 lbs. per panel.

h. Coverage: 8.88 sq. ft. per panel.

i. Factory sealed on six [6] sides.

C. Substitutions: Not permitted.

D. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 MATERIALS

A. Fiber cement panels manufactured from a pressed, stamped, and autoclaved mix of Portland cement, fly ash, silica, recycled rejects, and wood fiber bundles.

B. Panel surface pre-finished and machine applied.

C. Panels profiled along all four edges, such that both horizontal and vertical joints between the installed panels are ship-lapped.

D. Factory-applied sealant gasket added to top and right panel edges; all joints contain a factory sealant.

2.3 PERFORMANCE REQUIREMENTS:

A. Fiber Cement Cladding – Must comply with ASTM C-1186, Type A, Grade II requirements:

1. Wet Flexural Strength, lower limit: 1015 psi.
2. Water Tightness: No water droplets observed on any specimen.
3. Freeze-thaw: No damage or defects observed.
4. Warm Water: No evidence of cracking, delamination, swelling, or other defects observed.
5. Heat-Rain: No crazing, cracking, or other deleterious effects, surface or joint changes observed in any specimen.

B. Mean Coefficient of Linear Thermal Expansion (ASTM E-228): Max 1.0×10^{-5} in./in. F.

C. Surface Burning (CAN-ULC S102/ASTM E-84): Flame Spread: 0, Smoke Developed: 5.

D. Wind Load (ASTM E-330): Contact manufacturer for ultimate test pressure data corresponding to framing type, dimensions, fastener type, and attachment clips. Project engineer(s) must determine Zone 4 and 5 design pressures based on project specifics.

1. Minimum lateral deflection: L/120.

E. Water Penetration (ASTM E-331): No water leakage observed into wall cavity.

F. Weather Resistant (ASTM G-23): No cracking, checking, crazing, erosion, or other detrimental effects observed.

G. Steady-State Heat Flux and Thermal Transmission Properties Test (ASTM C-518): thermal resistance R Value of 1.23.

H. Fire Resistant (ASTM E-119): The wall assembly must successfully endure 60-minute fire exposure without developing excessive unexposed surface temperature or allowing flaming on the unexposed side of the assembly.

I. Ignition Resistance (NFPA 268): No sustained flaming of panels, assembly when subjected to a minimum radiant heat flux of $12.5 \text{ kW/m}^2 \pm 5\%$ in the presence of a pilot ignition source for a 20-minute period.

J. Fire Propagation (NFPA 285): Wall assembly of Nichiha AWP, Ultimate Clips and Starter Track, Tyvek Commercial Wrap, ½" Densglass Gold Sheathing, 16" o.c. 18 gauge steel

studs, mineral wool in-cavity insulation, and interior 5/8" Type X gypsum met the acceptance criteria of NFPA 285.

K. Fire Propagation (CAN/ULC S-134): Wall assembly of Nichiha AWP, Ultimate Clips and Starter Track, Tyvek Housewrap, 5/8" FRT plywood, 16" o.c. 2x wood studs, fiberglass in-cavity insulation, and interior 5/8" Type X gypsum met the acceptance criteria of CAN/ULC S-134.

L. Drained and Back Ventilated Rainscreen (AAMA 509-09): System must pass all component tests.

M. Florida Building Code - Test Protocol HVHZ (TAS 201, 202, 203): Passed.

2.4 INSTALLATION COMPONENTS

A. Ultimate Clip System:

1. Starter Track: FA 700 (10mm rainscreen) – 10' (3030mm) (I) galvalume coated steel.
2. Panel Clips: JEL 777 "Ultimate Clip" (10mm rainscreen for 5/8" AWP) – Zinc-Aluminum-Magnesium alloy coated steel.
 - a. Joint Tab Attachments (included) – used at all AWP-1818 panel to panel vertical joints.
3. Single Flange Sealant Backer – FHK 1017 (10mm) – 6.5' (I) fluorine coated galvalume.
4. Double Flange Sealant Backer – FH 1020 (10mm) – 10' (I) fluorine coated galvalume.
5. Corrugated Spacer – FS 1005 (5mm), FS 1010 (10mm) – 4' (I).
6. Finish Clip (optional) – JE310 (5mm)

B. Aluminum Trim (optional): Paint as specified in finish schedule.

C. Essential Flashing System (optional):

1. Starter – main segments (3030mm), inside corners, outside corners
2. Compression Joint – main segments (3030mm)
3. Overhang – main segments (3030mm), inside corners, outside corners, joint clips

D. Fasteners: Corrosion resistant fasteners, such as hot-dipped galvanized screws appropriate to local building codes and practices must be used. Use Stainless Steel fasteners in high humidity and high-moisture regions. Panel manufacturer is not liable for

- E. corrosion resistance of fasteners. Do not use aluminum fasteners, staples or fasteners that are not rated or designed for intended use. See manufacturer's instructions for appropriate fasteners for construction method used.
- F. Flashing: Flash all areas specified in manufacturer's instructions. Do not use raw aluminum flashing. Flashing must be galvanized, anodized, or PVC coated.
- G. Sealant: Sealant shall comply with ASTM C920, Class 35.

PART III: EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Fiber cement panels can be installed over braced wood, steel studs and sheathing including plywood, OSB, plastic foam or fiberboard sheathing. Fiber cement panels can also be installed over Structural Insulated Panels (SIP's), Concrete Masonry Units (CMU's) and Concrete Block Structures (CBS's) with furring strips, and Pre-Engineered Metal Construction. Insulated Concrete Forms (ICFs) are **NOT** an approved substrate under any condition.
2. Allowable stud spacing: 16" o.c. maximum.
3. A weather resistive barrier is required when installing fiber cement panels. Use an approved weather resistive barrier (WRB) as defined by the 2015 IBC or IRC. Refer to local building codes.
4. Appropriate metal flashing should be used to prevent moisture penetration around all doors, windows, wall bottoms, material transitions and penetrations. Refer to local building codes for best practices.

B. Examine site to ensure substrate conditions are within alignment tolerances for proper installation.

C. Do not begin installation until unacceptable conditions have been corrected.

D. Do not install panels or components that appear to be damaged or defective. Do not install wet panels.

3.2 TOLERANCE

A. Wall surface plane must be plumb and level within +/- ¼ inch in 20 feet in any direction.

1. One layer of Nichiha 5mm (~3/16") Spacer may be used as shim.

3.3 INSTALLATION

A. General: Install products in accordance with the latest installation guidelines of the manufacturer and all applicable building codes and other laws, rules, regulations and ordinances. Review all manufacturer installation, maintenance instructions, and other applicable documents before installation.

1. Consult with your local dealer or Nichiha Technical Department before installing any Nichiha fiber cement product on a building higher than 45 feet or three stories or for conditions not matching prescribed standard installation guide requirements and methods. Special installation conditions may be required via a **Technical Review and Special Applications Form (SAF)** process.

2. **Vertical Control/Expansion Joints** are required within 2-10 feet of outside corners finished with metal trim *and* approximately every 30 feet thereafter.

3. **Horizontal/Compression Joints** are required for multi-story installations of AWP. Locate joints at floor lines. Joints are flashed minimum ½” breaks. Do not caulk. Refer to installation guide(s).

A. Wood framed buildings of three or more floors require a compression joint at each floor.

B. Steel framed buildings (including reinforced concrete core with LGMF exterior walls) of more than three floors (or 45 feet) require a compression joint every 25 feet at a floor line.

B. Panel Cutting

1. Always cut fiber cement panels outside or in a well ventilated area. Do not cut the products in an enclosed area.

2. Always wear safety glasses and NIOSH/OSHA approved respirator whenever cutting, drilling, sawing, sanding or abrading the products. Refer to manufacturer SDS for more information.

3. Use a dust-reducing circular saw with a diamond-tipped or carbide-tipped blade.

a. Recommended circular saw: Makita 7-1/4” Circular Saw with Dust Collector (#5057KB).

b. Recommended blade: Tenryu Board-Pro Plus PCD Blade (#BP-18505).

c. Shears (electric or pneumatic) or jig saw can be used for complicated cuttings, such as service openings, curves, radii and scrollwork.

4. **Silica Dust Warning:** Fiber cement products may contain some amounts of crystalline silica, a naturally occurring, potentially hazardous mineral when airborne in dust form. Consult product SDS or visit <https://www.osha.gov/dsg/topics/silicacrystalline/>.

3.4 CLEANING AND MAINTENANCE

A. Review manufacturer guidelines for detailed care instructions.

SECTION 075423 - THERMOPLASTIC MEMBRANE ROOFING

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. Mechanically fastened thermoplastic polyolefin (TPO) membrane roofing system.
 - 2. Roof insulation related to single ply membrane roofing.
 - 3. Roof accessories and walkway pads.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking and for wood-based, structural-use roof deck panels.
 - 2. Division 7 Section "Building Insulation" for insulation beneath the roof deck.
 - 3. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.
 - 4. Division 7 Section Roof Accessories
 - 5. Division 7 Section Porcelain Roof Paver
 - 6. Division 22/23 Sections for roof drains.

1.03 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
- D. Exterior Fire-Test Exposure: Underwriters Laboratories UL Class A.
- E. Roof flashing details shall be consistent with those shown on the drawings. Where cap flashing is shown, a standard manufacturer's bar anchor only detail is not acceptable. Membrane

manufacturer's recommended flashing detail may be considered by the Architect when no detail is provided.

1.05 SUBMITTALS

- A. Submit in accordance with Section 013300.
- B. Product Data: For each type of product indicated. Provide installation instructions and general recommendations from manufacturer of thermoplastic membrane roofing system for types of roofing materials required.
- C. Shop Drawings: Submit shop drawings for roofing system approved by the manufacturer showing roof configuration, sheet layout, seam locations, colors (as applicable), details at perimeter, penetration and flashing details, attachments to adjacent Work, and special conditions. Customized detail sheets shall be prepared by manufacturer, showing each condition and approved installation method conforming with the construction drawing constraints and details.
 - 1. Base flashings and membrane terminations.
 - 2. Layout of tapered insulation and cricket materials, including slopes.
 - 3. Insulation fastening patterns.
- D. Samples for Verification: For the following products:
 - 1. 12-by-12-inch square of sheet roofing, of color specified.
 - 2. Blank sample of manufacturer's and Contractor's warranty forms.
- E. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- G. Qualification Data: For Installer.
- H. Maintenance Data: For roofing system to include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.
- J. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is factory trained and licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty. Contractor shall have a minimum of 3 years experience installing the system, have installed a minimum of 500,000 square feet and shall employ personnel experienced and skilled in the application of the manufacturer's roofing system.
 - 1. Work associated with TPO membrane roofing, including (but not limited to) insulation, flashing, and membrane sheet joint sealers, shall be performed by Installer of this Work.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing and FMG approval for membrane roofing system identical to that used for this Project.

- C. Source Limitations for Roofing Products: Obtain components for membrane roofing system from or approved by roofing membrane manufacturer.
- D. Source Limitations for Insulation Products: Obtain each type of roof insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
 - 1. Insulation shall be approved by roofing manufacturer for use with roofing system for a total system warranty.
- E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
- F. Insulation Fire Performance Characteristics: Provide insulation and related materials with the fire-test-response characteristics specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface Burning Characteristic: ASTM E 84.
 - 2. Fire Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.
- G. Roofing work shall be applied in strict accordance with the provisions of the specification criteria. No deviations shall be permitted without written consent from the Architect. Should a conflict between this specification and the manufacturer's requirements arise, the most restrictive provision as determined by the Architect shall govern.
- H. Upon completion of the installation, an inspection shall be made by the system manufacturer to ascertain that the roofing system has been installed according to the applicable manufacturer's specifications and details. No "early bird" warranty will be accepted. The results of the warranty inspection shall be submitted in writing to Owner and Architect for their review and records.
- I. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
 - 1. Meet with Owner, Architect, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories, skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 - 7. Review temporary protection requirements for roofing system during and after installation.
 - 8. Review roof observation and repair procedures after roofing installation.

9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
10. Provide 72-hour minimum advance notice to participants prior to convening preinstallation conference.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components. Comply with the manufacturer's written instructions for proper material storage and the following requirements:
 1. Store TPO membrane in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable, waterproof tarpaulins. TPO membrane that has been exposed to the elements for approximately 7 days must be prepared with manufacture's recommended membrane cleaner and in accordance with written instructions prior to hot air welding.
 2. Store curable materials (adhesives and sealants) between 60 and 80 deg F (15.5 and 26.7 deg C) in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60 deg F (15.5 deg C) minimum temperature before using.
 3. Store materials containing solvents in dry, well-ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Damaged materials shall be removed and replaced at the Installer's expense.
- E. Materials shall be delivered in sufficient quantity to allow continuity of the Work.
- F. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.
- G. Do not overload any portion of the building, either by use of or placement of equipment, storage of debris, or storage of materials. The loads of construction shall not exceed 25 pounds per square foot.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.
- C. Substrate Conditions: Do not begin roofing installation until substrates have been inspected and are determined to be in satisfactory condition. All surfaces shall be smooth, dry, clean, free

of fins or sharp edges, loose or foreign materials, oil or grease. No work shall proceed when moisture is present on the roof or in the substrate materials.

- D. Temporary waterstops shall be installed at the end of each workday and shall be removed before proceeding with the next day's work.
- E. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.
- F. Take precautions to prevent drains from clogging during the roofing application. Remove debris at the completion of each day's work and clean drains, if required. At completion, test drains to ensure the system is free running and drains are watertight. Remove strainers and plug drains in areas where work is in progress. Install flags or other telltales on plugs. Remove plugs each night and screen drain.
- G. If the exterior walls are not erected at the time of membrane installation, envelope the flutes of the metal deck to prevent moisture intrusion and wind damage.
- H. Coordinate work with that of other trades affecting or affected by the Work of this Section. Cooperate with such trades to ensure the steady progress of all work under this contract.

1.09 WARRANTY

- A. General: Special Warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Roofing Contractor shall furnish to the Owner the manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks. The maximum wind speed coverage shall be peak gusts of **72 mph (116 kmp)** measured at 10 meters above ground level. Warrantor shall be the manufacturer of the roofing membrane. Warranty shall be written to the building Owner.
 - 1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, substrate board, walkway products, and other components of membrane roofing system.
 - 2. Warranty Period: 15 years from date of Project Substantial Completion.
- C. When the warrantor is notified that there is a problem (leak or damage) with the warranted roofing system and/or accessories by telephone, and/or in writing (fax or mail), the response time to physically start the repairs shall be within twenty-four hour from time of telephone or date of written notification.
- D. No "Early Bird" warranties shall be issued.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE

- A. Fabric-Reinforced Thermoplastic Polyolefin (TPO) Sheet: Uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced, and as follows:
 1. Products:
 - a. Sure-Weld Roofing System; Carlisle SynTec Incorporated.
 - b. UltraPly TPO Roofing System; Firestone Building Products Company.
 2. Thickness: 45 mils, nominal. 60 mils under roof pavers.
 3. Exposed Face Color: Gray.
 4. Physical Properties:
 - a. Breaking Strength: 225 lbf; ASTM D 751, grab method.
 - b. Elongation at Break: 15 percent; ASTM D 751.
 - c. Tearing Strength: 55 lbf minimum; ASTM D 751, Procedure B.
 - d. Brittleness Point: Minus 22 deg F.
 - e. Ozone Resistance: No cracks after sample, wrapped around a 3-inch- diameter mandrel, is exposed for 166 hours to a temperature of 104 deg F and an ozone level of 100 pphm; ASTM D 1149.
 - f. Resistance to Heat Aging: 90 percent minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240 deg F; ASTM D 573.
 - g. Water Absorption: Less than 4 percent mass change after 166 hours' immersion at 158 deg F; ASTM D 471.
 - h. Linear Dimension Change: Plus or minus 2 percent; ASTM D 1204.

2.03 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard bonding adhesive for membrane, and bonding adhesive for base flashings. Provide adhesives that will withstand project wind uplift requirements.
- D. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- F. Adhesives and Cleaners: Provide bonding adhesive, edge sealant, water cut-off mastic, splicing cement, sealer, and membrane cleaner specifically formulated by the roofing manufacturer for the intended purpose and as required for a complete roof system. Provide adhesives that comply with project requirements to withstand 90-psf uplift force.

- G. Pipe Flashing: Provide membrane manufacturer's standard pre-molded flashing boot for flashing around pipe and conduit roof penetrations. Provide cone shaped flashing boot, heat welded to membrane with stainless steel clamping ring. Field-formed pipe flashing not allowed.
- H. Miscellaneous Accessories: Provide preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.04 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces, CAN/ULC S770, Grade 2, 20 psi minimum, LTTR R-values.
 - 1. Products:
 - a. Polyiso HP-H; Carlisle SynTec Incorporated.
 - b. Hy-Therm AP; Celotex Corporation.
 - c. ISO 95+; Firestone Building Products Company.
 - d. E'nrg'y 2; Johns Manville International, Inc.
 - 2. Provide roofing manufacturer's required insulation for total system warranty.
- B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.05 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Adhesive for Bonding Insulation: Manufacturer's standard adhesive, complying with fire-resistant requirements, formulated to adhere roof insulation to substrate.

2.06 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.
 - 1. Products:
 - a. Carlisle SynTec Incorporated; Sure-Weld Walkway Rolls.
 - b. Firestone Building Products Company; UltraPly TPO Walkway Pad.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck comply with requirements in Division 5 Section "Steel Deck."
4. Verify that plywood sheathing joints are supported by framing and blocking and that installation is within flatness tolerances specified in Division 6 Section "Rough Carpentry."
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with manufacturer's instructions to prepare substrate to receive TPO membrane roof system.
- B. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- D. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- E. Prime substrate where recommended by manufacturer of materials being installed.

3.03 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install insulation in two layers under area of roofing to achieve required thickness. Install layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 12 inches in each direction with no gaps, to form a complete thermal envelope.
 1. Provide two layers of 2 inch thick insulation at locations indicated as 4 inch insulation.
- D. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- F. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 1. Fasten insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
 - a. In no case shall there be less than 2 fasteners per piece of insulation.
 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
 3. Screws shall be installed utilizing automatic, positive clutch disengaged and adjustable nosepiece.

4. Fasteners which require pre-drilling shall be drilled to a minimum depth as recommended by the fastener manufacturer or required by Factory Mutual to permit full seating of the fastener into the plate.
- G. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
 1. Fasten to resist uplift pressure at corners, perimeter, and field of roof.
- H. Do not install more insulation in a day than can be covered with membrane before end of day or before start of inclement weather.

3.04 MECHANICALLY FASTENED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
 1. Flashing details shall be done in accordance with the drawing details and approved shop drawings. Base flashing shall be properly terminated and covered with counterflashing, providing not less than a 4-inch overlap.
 2. Provide a 10-foot by 10-foot additional layer of membrane at kitchen exhaust fans.
- E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- F. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
 - a. Cut out and repair membrane defects at the end of each day's work.
- G. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- H. In-Splice Attachment: Secure one edge of roofing membrane using fastening plates centered within membrane splice and mechanically fasten roofing membrane to roof deck. Field-splice seam.
- I. Install roofing membrane and auxiliary materials to tie in to asphalt shingle roofing.
- J. Perimeter membrane areas left exposed prior to fascia installation shall either be fully adhered to the vertical face or retained by a continuous cleat. Membrane shall extend down wall at least 1-inch past the bottom of the wood nailer, lapping over the wall finish, but not exposed below the flashing.

3.05 FLASHING INSTALLATION

- A. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using TPO reinforced membrane. TPO non-reinforced membrane can be used for flashing pipe penetrations, scuppers, as well as inside and outside corners when the use of pre-fabricated accessories is not feasible. Sealant pockets are not permitted.
- B. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions and approved shop drawing flashing details.
- C. At parapets and roof edges, flashing shall run under metal coping and flashing full length and width. Membrane shall extend down wall at least **1-inch (25 mm)** past the bottom of the wood nailer, lapping over the wall finish, but not exposed below the flashing.
- D. Flash all projections including pipes, conduits, and curbs passing through the membrane.
- E. Base Flashing: Tops of elastomeric base flashing shall be secured with a continuous aluminum termination bar and counterflashed.
- F. All vertical flashings and membranes shall be adhered to substrates regardless of height.
- G. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- H. Flash penetrations and field-formed inside and outside corners with sheet flashing conforming to manufacturer's requirements. A minimum overlap of 3-inches is required.
- I. Flash pipes and conduits with pre-molded cone type flashing boots. Do not field fabricate pipe flashing.
- J. Weld side and end laps to ensure a watertight seam installation.

3.06 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products to and around all mechanical equipment. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.07 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections 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.

3.08 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements. Retain below if coating membrane or if using fluid-applied bonding materials.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following sheet metal flashing and trim:
 - 1. Formed low-slope roof flashing and trim.
 - 2. Formed wall flashing and trim.
 - 3. Miscellaneous sheet metal accessories.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry Assemblies" for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
 - 2. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 3. Division 7 Sections "Insulated-Core Metal Wall Panels", Polysio and Fiber Cement Wall Panels" for factory-formed metal wall panels and flashing and trim not part of sheet metal flashing and trim.
 - 4. Division 7 Section "Thermoplastic Membrane Roofing" for installing sheet metal flashing and trim integral with roofing membrane.
 - 5. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Thermal Movements: Provide sheet metal flashing, and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Water Infiltration: Provide sheet metal flashing, and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

- A. General: Submit in accordance with Section 01330.

- B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Show details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories. Distinguish between shop- and field-assembled work. Provide layouts at 1/4-inch scale and details at 3-inch scale. Include the following:
 - 1. Identify material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
 - 4. Details of connections to adjoining work.
- D. Samples: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches long, of each color selected by Architect. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Roof Edge Trim: 12 inches long. Include fasteners and other exposed accessories. Provide in colors required for project.

1.5 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.
- B. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation to ensure a weathertight installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 SHEET METALS

- A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - 1) Color: Shall match color of composite wall panel, ACM.
 - 2) Material to be obtained from the manufacturer of composite wall panels to assure color match.
- B. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 2. Exposed Finishes: Apply the following coil coating:
 - a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:
 - a) Humidity Resistance: 2000 hours.
 - b) Salt-Spray Resistance: 2000 hours.
 - 2) Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
 - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 - 4. Fasteners Installed in Preservative Treated Wood: Stainless steel.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- F. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing, and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing, and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing, and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat- lock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric

sealant concealed within joints.

- F. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by fabricator.
- G. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- H. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.5 FABRICATED FLASHING SCHEDULE

- A. Roof Edge Strip for Single Ply Membrane Roofing: SMACNA, Figure 2.5C; continuous edge clip; 6-inch flange on roof; fabricate from the following materials:
 - 1. At Composite Wall Panels: Prefinished, aluminum sheet, minimum 0.040 inch thickness; color to match composite wall panel, ACM.
 - 2. At Insulated Metal Wall Panels: Prefinished, aluminum-zinc alloy-coated sheet steel, minimum 24 gage; color as selected by Architect.
- B. Parapet Coping: Shop formed to detail with continuous clip; joint detail per Table 3-1, joint style J-10 and edge style E1; continuous TPO roofing membrane over blocking and down onto face of wall with coping edges lapped down to cover barrier strip; coping sloped to interior of building. Fabricated from prefinished, aluminum sheet, minimum 0.040 inch thickness; color to match composite wall panel, ACM.
- C. Masonry Flashing: Shop formed to detail with continuous edge clip; joint detail per Table 3-1, joint style J-10 and edge style E1; continuous barrier strip over wood blocking, turned up wall and turned down face of blocking, lapping over face of CMU; face of ledge flashing to lap over face of CMU, 1-1/2 inches minimum; slope flashing to drain. Fabricated from prefinished, aluminum sheet, minimum 0.040 inch thickness; color to match composite wall panel, ACM.
- D. Counter Flashing for Roof Membrane: SMACNA, Figure 4.4C; turn vertical leg up 8 inches; make horizontal leg run back to wall sheathing and turn up not less than 4 inches, flash into air/vapor barrier system; fabricate from prefinished, aluminum sheet, minimum 0.040 inch thickness; color to match composite wall panel, ACM.
- E. Miscellaneous Flashing: Shop formed to detail; fabricate from the following materials:
 - 1. At Composite Wall Panels: Prefinished, aluminum sheet, minimum 0.040 inch thickness; color to match composite wall panel, ACM.
 - 2. At Insulated Metal Wall Panels: Prefinished, aluminum-zinc alloy-coated sheet steel, minimum 24 gage; color as selected by Architect.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the 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 the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 - 1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight

performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Cleats shall be continuous, unless otherwise noted.

- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
1. Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
 2. Aluminum: Use aluminum or stainless-steel fasteners.
- H. Seal joints with elastomeric sealant as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with installation requirements in Division 7 Section "Joint Sealants."

3.3 FABRICATED FLASHING AND TRIM INSTALLATION

- A. General: Except as otherwise indicated, comply with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible and set units true to line and level as indicated. All edge strips shall be neatly folded, external and internal corners shall be mitered and sealed in full bed of water cut off mastic for pre-finished metal. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Back-Up Plates: Where specified, set flashing ends in full bed of water cut-off mastic, allowing 1/4-inch between sections.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
1. Secure in a waterproof manner by means of snap-in installation or welding in-place. Fill reglets with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.
- D. Install flashing and sheet metal with concealed fasteners, unless indicated otherwise. Metal edge flashing shall be installed to resist wind blow-off and prevent flutter and vibration. Allow for expansion and contraction, making square, straight corners and tight overlaps, free of gaps and openings, properly sealed to be watertight.

- E. Electrolytic Action: Where two (2) dissimilar metals adjoin or lap each other (example: galvanized metal ducts and copper cap flashing), an approved separating strip or other insulating material shall be installed.
- F. Bed flanges of work in water cut off mastic where required for waterproof performance.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Miscellaneous Accessories
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for ladders and miscellaneous metal framing and supports.
 - 2. Division 6 Section "Rough Carpentry" for wood nailers.
 - 3. Division 7 Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, fasciae, and miscellaneous sheet metal trim and accessories.
 - 4. Division 7 Sections for raised porcelain plank deck system.

1.3 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: For each type of product indicated. Include manufacturer's detailed technical product data; installation instructions and recommendations. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, rough- in requirements, elevations, sections, details, and attachments to other Work.

1.4 QUALITY ASSURANCE

- A. Standards: Comply with the following:
 - 1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
 - 2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Aluminum Sheet: ASTM B 209 for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.

- B. Extruded Aluminum: ASTM B 221 alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.
- C. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.
- D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.
- E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.
 - 1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.
- F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.
- H. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- I. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

2.2 MISCELLANEOUS ACCESSORIES

- 1. Accessories to complete installation of roof items.

2.3 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the 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 the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 ACCESSORY ITEMS

- A. General: Comply with manufacturer's written instructions and recommendations. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.
- B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated.
- C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
- D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing mastics to form a seal.
- E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.
- F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.2 CLEANING AND PROTECTION

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

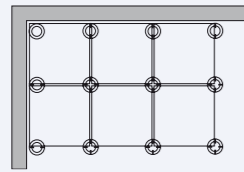
END OF SECTION 077200

SUPPORTO REGOLABILE "ETERNO" CON TESTA AUTOLIVELLANTE IN BIMATERIALE (PP+GOMMA)



ADJUSTABLE PAVING SUPPORT "ETERNO" WITH SELF-LEVELLING HEAD SOPORTE REGULABLE "ETERNO" CON CABEZAL AUTONIVELANTE DE DOS MATERIALES (PP+GOMA)

ESEMPIO DI APPLICAZIONE
APPLICATION EXAMPLE
EJEMPLO DE APLICACIÓN



Misura quadrotto Paving slab size Medidas de la baldosa	Quantità m ² Pieces per m ² Cantidad m ²
cm 60 x 60	2,78 supporti / pcs / soportes
cm 50 x 50	4 supporti / pcs / soportes
cm 40 x 40	6,25 supporti / pcs / soportes
cm 30 x 30	11,11 supporti / pcs / soportes

Schema composizione SE0-SE14
Composition table SE0-SE14
Componentes - SE0-SE14

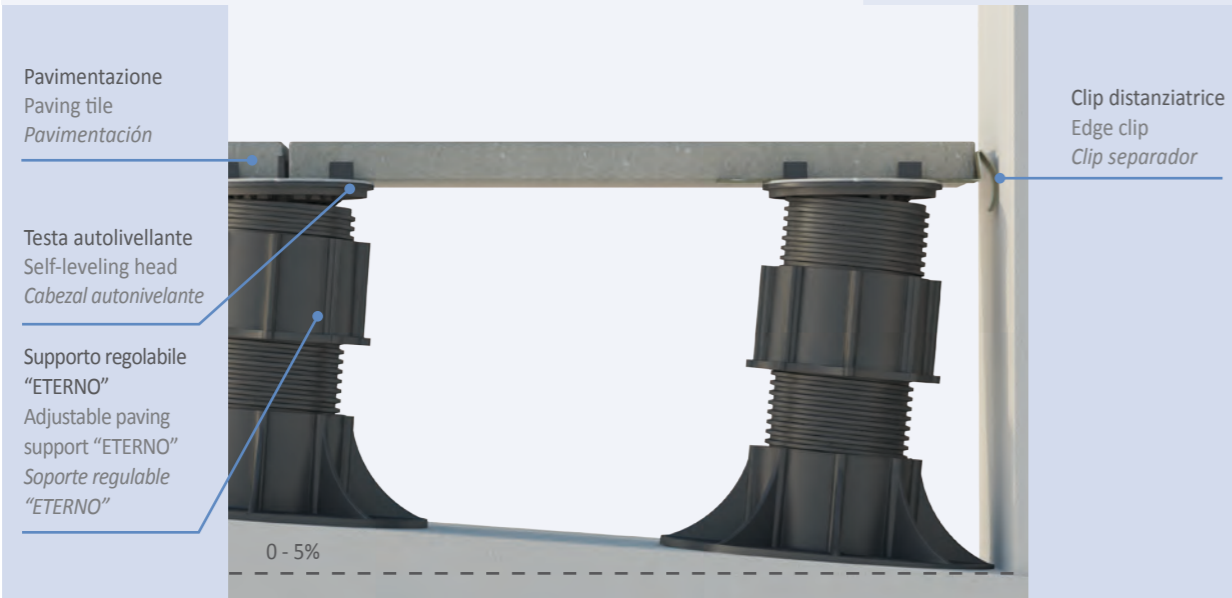
SE0 = SE0	SE8 = SE5 + 1xP1
SE1 = SE1	SE9 = SE3 + 2xP1
SE2 = SE2	SE10 = SE4 + 2xP1
SE3 = SE3	SE11 = SE5 + 2xP1
SE4 = SE4	SE12 = SE3 + 3xP1
SE5 = SE5	SE13 = SE4 + 3xP1
SE6 = SE3 + 1xP1	SE14 = SE5 + 3xP1
SE7 = SE4 + 1xP1	

- Centro pavimento
In the middle
Centro del pavimento
- Bordo muro
Along the wall
Borde de la pared
- Angolo muro
At the corner
Esquina de la pared

N.B.: nel caso le dimensioni fossero diverse, si prega di contattare il ns. ufficio tecnico.
N.B.: in case of different sizes, please contact our technical department.
N.B.: en caso de que las dimensiones sean diferentes, se ruega contactar con el departamento técnico.

PAG. LISTINO
PAGE LIST
PÁG. LIST.

04



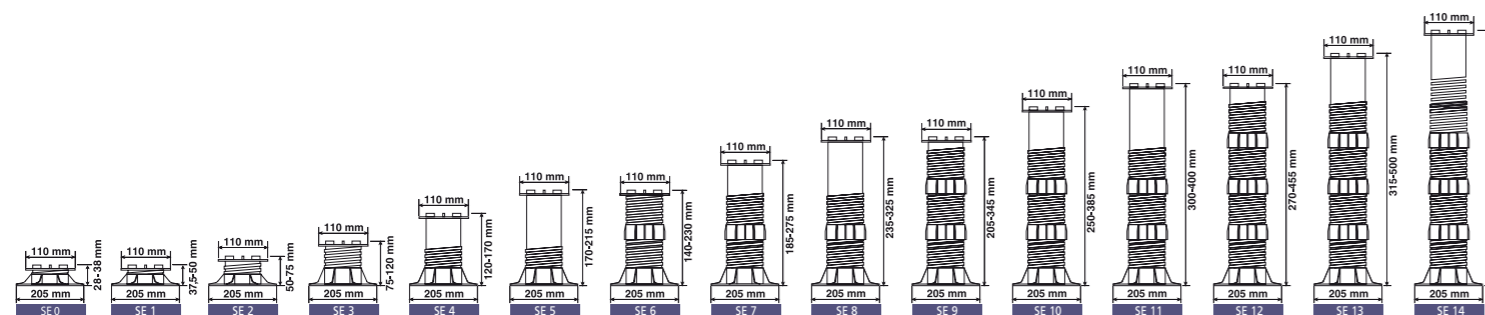
Pavimentazione
Paving tile
Pavimentación

Testa autolivellante
Self-leveling head
Cabezal autonivelante

Supporto regolabile
"ETERNO"
Adjustable paving support
"ETERNO"
Soporte regulable
"ETERNO"

Clip distanziatrice
Edge clip
Clip separador

0 - 5%



Codice Code Codigo	Tipo Type Tipo	Misura Size Medida	Pz	Pz	Codice Code Codigo	Tipo Type Tipo	Pz	Pz
E240028038	SE 0	28-38 mm	50	1500	E130125000	Prolunga P1* P1 Extension element* P1 Prolongacion*	40	1200
E240037050	SE 1	37,5-50 mm	40	1200	E082002000	Livellatore gomma LGH2mm LGH2mm rubber shim Nivelador de goma LGH2mm	600	42000
E240050075	SE 2	50-75 mm	30	900	E082003000	Livellatore gomma LGH3mm LGH3mm rubber shim Nivelador de goma LGH3mm	500	35000
E240120170	SE 4	120-170 mm	25	500	E200250120	Chiave di regolazione** Adjustment key** Llave de regulación**	1	-
E240170215	SE 5	170-215 mm	25	500	P021000220	Clip universale per spessore pavimento Universal edge clip Clip universal para pavimento		
E240140230	SE 6	140-230 mm	-	-	P021000102	Clip per spessore pavimento 20 mm Edge clip 20 mm Clip para pavimento de 20 mm de espesor	450	-
E240185275	SE 7	185-275 mm	-	-	P021000102	Clip per spessore pavimento 20 mm Edge clip 20 mm Clip para pavimento de 20 mm de espesor	450	-
E240235325	SE 8	235-325 mm	-	-	P021000103	Clip per spessore pavimento da 26 a 33 mm Edge clip for 26 to 33 mm tiles Clip para pavimento de 26 a 33 mm de espesor	450	-
E240205345	SE 9	205-345 mm	-	-	E035101204	Testa bicomponente autolivellante. Alette H12mm Bi-component autolevelling head. Tabs H12mm Cabezal autonivelante de dos materiales. Aletas H12mm		
E240250385	SE 10	250-385 mm	-	-	E150030004	Testa Plus-Tec. Aletta H 23mm spessore 4 mm*** Plus-Tec Head. Tabs H 23mm thickness 4 mm*** Cabezal Plus-Tec. Aletas H 23mm espesor 4 mm***		
E240300400	SE 11	300-400 mm	-	-				
E240270455	SE 12	270-455 mm	-	-				
E240315500	SE 13	315-500 mm	-	-				
E240365550	SE 14	365-550 mm	-	-				

NB: I codici si riferiscono al modello con testa autolivellante con alette spessore 4 mm H 12 mm

Codes refer to type with self-levelling head with 4 mm thick tabs, H 12 mm

N.B.: Los códigos se refieren al modelo con cabezal autonivelante con aletas de 4 mm de espesor y 12 mm de altura.

* Prolunga utilizzabile solo con supporti da SE3 a SE14.
Extension element suitable only to types from SE3 to SE14.

Prolongación utilizable solo con soportes de SE3 a SE14.

** Utilizzabile solo con alette spess. 4 mm.

Suitable only with standard 4mm thick tabs.

Utilizable solo con aletas de 4 mm de espesor.

*** Disponibile anche liscia
Flat head also available
Disponibile lisa tambien

Alette con spessore standard 4 mm H 12 mm, su richiesta 2 - 3 mm o liscia e H 20 mm.
Standard tabs are 4 mm thick H 12 mm. On request also 2 - 3 mm or flat and H 20 mm.
Aletas con espesor estándar de 4 mm y 12 mm de altura; bajo pedido, 2 - 3 mm o lisa y 20 mm de altura.



SE 0	SE 1	SE 2	SE 3	SE 4	SE 5	SE 6	SE 7
28 - 38 mm	37,5 - 50 mm	50 - 75 mm	75 - 120 mm	120 - 170 mm	170 - 215 mm	140 - 230 mm	185 - 275 mm



SE 8	SE 9	SE 10	SE 11	SE 12	SE 13	SE 14	LGH2 - LGH3
235 - 325 mm	205 - 345 mm	250 - 385 mm	300 - 400 mm	270 - 455 mm	315 - 500 mm	365 - 550 mm	2 - 3 mm

SECTION 077616 – PORCELAIN ROOF PAVERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Porcelain roof pavers.
- B. Pedestal supports and pads for roof pavers.

1.2 RELATED REQUIREMENTS

- A. Division 07 waterproofing section for protection mats for waterproofing membrane at pedestal support locations.
- B. Division 07 roofing section for protection mats for roof membrane and insulation cover boards at pedestal support locations.
- C. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing, edge closure, and roof drainage items.

1.3 REFERENCE STANDARDS

- A. American Society of Civil Engineers (ASCE) Structural Engineering Institute (SEI):
 - 1. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.
- B. ASTM International (ASTM):
 - 1. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings
 - 2. ASTM E 1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site as part of roofing conference in coordination with installers of related work.
 - 1. Coordinate roof substrate protection installation, roof drain locations, and other elements affecting roof pavers.
 - 2. Verify compatibility of roofing system installation with load-bearing requirements of roof paver supports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced Installer with record of successful in-service performance of similar installations, and approved in writing by roof paver manufacturer.

- B. Mockups: Build mockup in size and location indicated on Drawings, or if not indicated, not less than eight roof pavers and roof paver supports plus edge condition. Demonstrate methods and details of installation.
 - 1. Approval of mockup does not relieve Contractor of responsibility to comply with all requirements of contract documents.
 - 2. Approved mockup may become part of installation if approved by Architect.

1.6 ACTION SUBMITTALS

- A. Product Data: Manufacturer's product data for specified products indicating compliance with requirements.
- B. Shop Drawings: Provide shop drawings. Include full plans showing roof paver and roof paver supports layout, adjacent construction and penetrations, and details of each condition of installation and attachment.
 - 1. Include data indicating compliance with performance requirements.
 - 2. Indicate points of supporting structure and other construction elements that must coordinate with roof paver installation.
- C. Samples for Initial Selection: For each product specified, when selection is specified. Provide representative charts of manufacturer's full range of patterns and colors.
- D. Samples for Verification: Provide manufacturer's standard size roof paver samples.

1.7 INFORMATIONAL SUBMITTALS

- A. Installer qualifications.
- B. Product Test Reports: Indicating compliance of products with performance requirements, from a qualified independent testing agency.
- C. Manufacturer's Warranty: Submit sample warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Executed warranty.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials matching installed products, packaged with protective covering, with labels indicating contents.
 - 1. Roof Pavers: Furnish full size units in quantity equal to 3 percent of number of units installed, for each type, pattern, color, and size.
 - 2. Roof Paver Supports: Furnish units in quantity equal to 3 percent of number of units installed, for each type and size. Include manufacturer-furnished adjustment tool.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect products during shipping, handling, and storage to prevent staining, chipping, deterioration of components or other damage.

1.11 WARRANTY

- A. Manufacturer's Warranty: On Manufacturer's standard form, in which Manufacturer and Installer jointly agree to replace roof pavers and roof paver supports that fail in materials or workmanship within three years of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Provide listed porcelain roof pavers meeting requirements of this Section, available from HandyDeck Inc., 2 Wisconsin Circle, Suite 700, Chevy Chase MD 20815; (866) 206-8316; tileinfo@handydeck.com; www.handydeck.com .
- B. Substitutions: [In accordance with Instructions to Bidders and Division 01 General Requirements] [Not allowed].
- C. Source Limitations: Obtain each type of roof paver and roof paver support products from a single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design roof paver installation.
- B. Structural Performance: Roof paver system shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Floors: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
 - 2. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft.
 - 3. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft.
 - 4. All Roof Zones (Corner, Perimeter, and Field-of-Roof) Uplift Pressures: As indicated on Drawings.
 - 5. Roof Zone 1 (Field-of-Roof) Uplift Pressure: 13.2 lbf /sq. ft.
 - 6. Roof Zone 2 (Perimeter) Uplift Pressure: 13.2 lbf /sq. ft.
 - 7. Roof Zone 3 (Corners) Uplift Pressure: 13.2 lbf /sq. ft.
- C. Solar Reflectance Index (SRI): SRI not less than [78] when calculated according to ASTM E 1980.
- D. Combustion Characteristics: Roof paver system shall meet Class A flame spread requirements of ASTM E 108 when tested by a qualified independent testing laboratory acceptable to authorities having jurisdiction.

2.3 PORCELAIN ROOF PAVERS

- A. Structural Porcelain Pavers: Porcelain pavers, abrasion, freeze/thaw, chemical, and stain-resistant, intended for exterior use on specified paver supports.
1. Basis of Design: [HandyDeck, Kronos Ceramiche SPA](#), Deckway Porcelain Planks [color and pattern as selected by Architect].
 2. Size: 94" long x 12" wide.
 3. Accessories: As required for complete installation.
 4. Plank Thickness: 3/4"
 5. Plank Weight: 67 lbs. each

2.4 PAVER SUPPORTS

- A. Adjustable Height Pedestal Supports: Continuously variable adjustable height high-density copolymer polypropylene screw-jack-type supports accommodating height adjustments from 1-1/8 inch to 21-3/4 inches and slope substrate compensation up to five percent, with cushioned SBR rubber top fitting providing support for specified pavers, and adjustable fittings as required to provide level paver installation as indicated.
1. Basis of Design Product: [HandyDeck, Eterno Adjustable Pedestal System](#).
 2. Load Capacity: Not less than 2,000 lb.
 3. Paver Spacer Tabs: 5/32 inch (4 mm).
 4. Shims: Support manufacturer's standard.
- B. Fixed Height Pad Supports: SBR rubber cushioning pads of varying thickness with shims and spacers, accommodating height adjustments from 3/8 inch to 1-1/2 inch, with top fitting providing support for specified pavers.
1. Basis of Design Product: [HandyDeck Fixed Height Paver Supports](#).
 2. Load Capacity: Not less than 1,500 lb.
 3. Paver Spacer Tabs: 5/32 inch (4 mm).
 4. Shims: Support manufacturer's standard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with manufacturer's requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate placement of protection sheet at roof paver supports with work of roofing section.
- B. Lay out roof paver and roof paver support locations and mark for application of protection sheet.

3.3 INSTALLATION, ROOF PAVER SUPPORTS

- A. General: Set roof paver supports in locations coordinated with approved roof paver layout. Install in accordance with support manufacturer's written instructions and approved submittals. Adjust roof paver support heights prior to, and following, installation of roof pavers. Shim where fine adjustment is necessary using manufacturer-provided shims.
- B. Tolerances for Roof Paver Supports:
 - 1. Maximum of 1/16-inch height variation between adjacent roof pavers.
 - 2. Individual roof pavers shall not vary more than 1/16 inch from level across width of the paver.
 - 3. Paved areas shall not vary more than 1/4 inch from level in a distance of 10 feet measured at any location and in any direction.

3.4 INSTALLATION, PAVERS

- A. Install roof pavers according to manufacturer's written instructions and approved shop drawings. Set in place using placement methods that result in stable installation free from rocking using sound roof pavers with no edge or surface damage. Make final in-place height adjustments using manufacturer's furnished tool.

3.5 CLEANING AND PROTECTION

- A. Remove and replace loose, chipped, broken, stained or otherwise damaged roof pavers, or if roof pavers do not match adjoining units or pattern indicated on Drawings.
- B. Cleaning: Remove soiling from exposed roof paver surfaces, wash and scrub clean. Leave joints between roof pavers open and clean of debris to allow for proper drainage and air flow.
- C. Provide final protection and maintain roof pavers without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 078410 - THROUGH-PENETRATION FIRESTOP SYSTEMS

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 through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
 - 1. Floors.
 - 2. Ceilings.
 - 3. Walls and partitions.
- B. Related Sections include the following:
 - 1. Division 7 Section "Building Envelope Air Sealing".
 - 2. Division 9 Section "Gypsum Board Assemblies" for firestopping where fire rated gypsum board assemblies butting adjacent construction.
 - 3. Division 23 Sections specifying duct and piping penetrations.
 - 4. Division 26/27 Sections specifying cable and conduit penetrations.

1.03 PERFORMANCE REQUIREMENTS

- A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
 - 1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
 - 2. Fire-resistance-rated floor assemblies.
 - 3. Fire-resistance-rated ceiling assemblies.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - 1. Penetrations located outside wall cavities.
 - 2. Penetrations located outside fire-resistive shaft enclosures.
 - 3. Penetrations located in construction containing fire-protection-rated openings.
 - 4. Penetrating items larger than 4-inch- diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

- D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
 - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
 - 4. Products in public areas shall be paintable.
- E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.
- F. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per UL 2079, but not less than that equaling or exceeding fire-resistance rating of construction in which joint occurs. Comply with LEED low emitting materials - adhesives and sealants.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: For each type of through-penetration firestop system product indicated. List product characteristics, typical uses, performance and limitation criteria, and test data.
 - 1. Include manufacturer's installation instructions for each product.
- C. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Indicate which firestop materials will be used where and thickness for different hourly ratings. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
 - 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.
 - 3. For those firestop applications that exist for which no UL tested system is available through manufacturer, manufacturer's engineering judgement derived from a similar UL system design or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineering judgement shall follow requirements set forth by the International Firestop Council.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project

names and addresses, names and addresses of architects and owners, and other information specified.

- E. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
- F. Product Test Reports: From an independent qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in "Fire Resistance Directory."
- D. Provide through-penetration firestop system products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, subpart F, Appendix A, Section 1, "Polarized Light Microscopy. "
- E. Field-Testing: Each type of through-penetration firestop system shall be field-tested.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.

- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.08 COORDINATION

- A. Coordinate Work of this Section with the work of other trades to assure the proper sequencing of each installation and to provide a smoke- and fire-resistant installation.
- B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- C. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- D. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- E. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Bio Fireshield, Carlisle, MA.
 2. W. R. Grace & Co., Construction Products Division.
 3. Hilti Construction Chemicals, Inc.
 4. Isolatek International.
 5. Nelson Firestop Products.
 6. Specified Technologies Inc.
 7. 3M Fire Protection Products.

2.02 FIRESTOPPING, GENERAL

- A. Firestop Systems: All through-penetration firestop products and systems shall be designed and installed so the basic sealing system will allow the full restoration of thermal and fire-resistance

properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

1. Provide paintable through-penetration firestop products at locations exposed to the public. Mechanical, electrical and elevator machine rooms are not considered public spaces.
- B. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- C. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.03 FILL MATERIALS -ADHESIVES AND SEALANTS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
1. Product:
 - a. CP 680 Cast-In-Place Firestop Device; Hilti Construction Chemicals, Inc.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
1. Products:
 - a. Biostop 500+ Intumescent Firestop; Bio Fireshield.
 - b. FlameSafe FS900 Sealant; W. R. Grace & Co.
 - c. Fire Barrier CP 25WB+; 3M Fire Protection Products.
 - d. SpecSeal LC 150 Sealant; Specified Technologies Inc.

- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
1. Products:
 - a. Biostop Pipe Collar; Bio Fireshield.
 - b. FlameSafe FSWS Series FlameSafe Devices; W. R. Grace & Co.
 - c. CP 642 and CP 643 Firestop Jacket; Hilti Construction Chemicals, Inc.
 - d. SpecSeal Series LCC and Series SSC Firestop Collars; Specified Technologies Inc.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
1. Products:
 - a. Biostop Composite Sheet; Bio Fireshield.
 - b. CS-195_ Composite Sheet; 3M Fire Protection Products.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
1. Products:
 - a. FlameSafe FSP 1000 Putty and FSP 1077 Putty Pads; W. R. Grace & Co.
 - b. CP 617 and CP 618 Putty Pads and Putty Sticks; Hilti Construction Chemicals, Inc.
 - c. MPS-2 Moldable Putty Stix and Putty Pads; 3M Fire Protection Products.
 - d. Spec-Seal Firestop Putty Bars and Putty Pads; Specified Technologies Inc.
- G. Intumescent Wrap Strips with Foil: Single-component intumescent elastomeric sheets with aluminum foil on one side.
1. Products:
 - a. CP 645 Wrap Strips; Hilti Construction Chemicals, Inc.
 - b. Fire Barrier FS-195+ Wrap Strip; 3M Fire Protection Products.
- H. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets.
1. Products:
 - a. Biostop Wrap Strip; Bio Fireshield.
 - b. SpecSeal Series SSWBLU and Series SSWRED Intumescent Wrap; Specified Technologies Inc.
- I. 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 non-shrinking, homogeneous mortar.
1. Products:
 - a. FlameSafe Mortar Safe; W. R. Grace & Co.
 - b. CP 636 Firestop Mortar; Hilti Construction Chemicals, Inc.
 - c. SpecSeal Firestop Mortar; Specified Technologies Inc.
- J. 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.
1. Products:
 - a. Bio Firestop Pillows; Bio Fireshield.
 - b. FlameSafe Bags and FlameSafe Pillows; W. R. Grace & Co.
 - c. CP 651 Firestop Cushion; Hilti Construction Chemicals, Inc.
 - d. SpecSeal Firestop Pillows; Specified Technologies Inc.

- K. Silicone Foams: Multi-component, silicone-based liquid elastomer that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
1. Products:
 - a. CP 620 Firestop Foam; Hilti Construction Chemicals, Inc.
 - b. Fire Barrier 2001 Silicone RTV Foam; 3M Fire Protection Products.
 - c. SpecSeal Pen 200 Silicone Foam; Specified Technologies Inc.
- L. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - a. Products:
 - 1) Biotherm 200SL Firestop Sealant; Bio Fireshield.
 - 2) CP 604 Self-Leveling Firestop Sealant; Hilti Construction Chemicals, Inc.
 - 3) Fire Barrier 1003SL; 3M Fire Protection Products.
 - 4) SpecSeal Pen 300 Silicone Sealant; Specified Technologies Inc.
 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - a. Products:
 - 1) Biotherm 200SL Firestop Sealant; Bio Fireshield.
 - 2) CP 604 Self-Leveling Firestop Sealant; Hilti Construction Chemicals, Inc.
 - 3) Fire Barrier 1003SL; 3M Fire Protection Products.
 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
 - a. Products:
 - 1) Biotherm 100 Firestop Sealant; Bio Fireshield.
 - 2) CP 601S Elastomeric Firestop Sealant; Hilti Construction Chemicals, Inc.
- M. Accessories: Forming/damming materials composed of mineral fiberboard or other type as recommended by through-penetration firestop systems manufacturer.

2.04 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.03 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.
 - 1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

- B. Allow for 3 random samples of each type of firestopping system to be inspected. Reinstall disturbed samples to comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.
- D. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 078410

SECTION 079200 - JOINT SEALANTS

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 joint sealants for interior and exterior applications.
- B. Related Sections include the following:
 - 1. Division 2 Sections for sealing joints in pavements, walkways, and curbing.
 - 2. Division 7 Section for sealant used for with siding and trim in conjunction with windows, doors, louvers and ACM.
 - 3. Division 7 Section "Through-Penetration Firestop Systems" for sealing joints in fire-resistance-rated construction.
 - 4. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission and for smoke at smoke partitions.
 - 5. Division 9 Section "Ceramic Tile" for sealing tile joints.

1.03 PERFORMANCE REQUIREMENTS

- A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: For each joint-sealant product indicated.
- C. Samples for Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in materials, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, shelf/pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Remove and replace materials, at no cost to Owner that cannot be applied within their stated shelf life.

1.07 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation to ensure a weathertight installation.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Exposed Joint Sealants: Products exposed to view in public areas shall be paintable. Mechanical, electrical and elevator machine rooms are not considered public spaces.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 JOINT SEALANTS

- A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type S, Grade NS, Class 25; single component
 - 1. Sonolastic NP-1; Sonneborn, Division of ChemRex Inc.
 - 2. Dymonic; Tremco.
 - 3. Sikaflex-1a; Sika Corporation, Inc.
 - 4. Dynatrol 1; Pecora Corporation.
 - 5. Vulkem 921; Tremco.
 - 6. Chem-Calk 900; Bostik Findley.

- B. Type 2 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type M, Grade NS, Class 25; two-component.
 - 1. Sonolastic NP-2; Sonneborn, Division of ChemRex Inc.
 - 2. Dymeric; Tremco.
 - 3. Sikaflex-2c, NS; Sika Corporation, Inc.
 - 4. Dynatrol 2; Pecora Corporation.
 - 5. Vulkem 922; Tremco.
 - 6. Chem-Calk 500; Bostik Findley.

- C. Type 3 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
 - 1. Tremco Acrylic Latex; Tremco.
 - 2. AC-20; Pecora Corporation.
 - 3. Chem-Calk 600; Bostik Findley.

- D. Type 4 - Plumbing Fixture/Tile Sealant: Silicone; ASTM C920, Uses M and A; single component, mildew resistant, color selected by Architect.
 - 1. Sanitary 1700; GE Silicones.
 - 2. 898 Silicone; Pecora Corporation.
 - 3. 786 MR Silicone; Dow Corning Corporation.

- E. Type 5 - Acoustical Sealant: Butyl or acrylic sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
 - 1. Tremco Acoustical Sealant; Tremco.
 - 2. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.

2.03 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Plastic Foam Joint Fillers (Backer Rods): Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or

joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.04 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where indicated or recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

- D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
1. Install sealant backings of type indicated to provide support of sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture, or tear joint fillers.
 2. Install bond-breaker tape behind sealants where backer rods are not used between sealants and joint fillers or backs of joints.
- E. Installation of Sealants: Install sealants using proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.04 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 JOINT-SEALANT SCHEDULE

- A. Under Exterior Door Thresholds: Type 1.
- B. Exterior Joints for Which No Other Sealant Type is Indicated: Type 2; colors as selected.
- C. Concealed Interior Perimeter Joints of Exterior Openings: Type 1.
- D. Exposed Interior Perimeter Joints of Exterior Openings: Type 3; colors as selected.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

- E. Interior Ceramic Tile Expansion, Control, Contraction, and Isolation Joints in Horizontal Traffic Surfaces: Type 2; color as selected.
- F. Joints between Plumbing Fixtures and Walls and Floors and Between Countertops and Walls: Type 4; colors as selected.
- G. Interior Joints for Which No Other Sealant is Indicated: Type 3; colors as selected.

END OF SECTION 079200

SECTION 081100 - STEEL DOORS AND FRAMES

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. Steel frames.
 - 2. Steel doors
- B. Related Sections include the following:
 - 1. Division 8 Section "Door Hardware" for door hardware for steel frames.
 - 2. Division 9 painting Sections for field painting steel doors and frames.

1.03 DEFINITIONS

- A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
 - 1. Submittals for Sections 08110, 08211 and 08710 shall be made concurrently.
- B. Product Data: Include door designation, type, level and model, construction details, material descriptions, core descriptions, label compliance, fire-resistance rating and finishes for each type of steel door and frame specified.
- C. Shop Drawings: In addition to requirements below, provide a schedule of steel doors and frames using same reference numbers for details and openings as those on Drawings:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details.
 - 3. Frame details for each frame type, including dimensioned profiles.
 - 4. Details and locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, accessories, joints, and connections.
- D. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for steel doors and frames.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain steel frames through one source from a single manufacturer.

- B. Fire-Rated Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
 - 1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non vented plastic.
- B. Deliver knock down frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Inspect frames on delivery for damage; notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.
- D. Store frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inches high wood blocking. Avoid using non vented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Steel Frame Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door Products; an ASSA ABLOY Group Company.
 - 2. CURRIES Company; an ASSA ABLOY Group Company.
 - 3. Steelcraft; an Ingersoll-Rand Company.

2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

- D. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching steel door frames of type indicated.

2.03 STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
- B. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
 - 1. Fabricate frames with mitered or coped and knock down face corners and seamless face joints, unless otherwise indicated.
 - 2. Frames for Level 2 Steel Doors: **0.053-inch** thick (16 gage) steel sheet.
 - 3. Frames for Wood Doors: **0.053-inch** thick (16 gage) steel sheet, unless otherwise indicated.
 - 4. All joints shall be ground and dressed to be smooth, flush, and invisible.
- C. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as frames to support hardware without through bolting and to comply with the following minimum sizes:
 - 1. Hinges: Minimum **0.123-inch** thick (10 gage) by **1½-inches** wide by **6-inches** longer than hinge, secured by not less than 6 spot welds.
 - 2. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum **0.067 inch** thick (14 gage).
 - 3. All Other Surface-Mounted Hardware: Minimum **0.067 inch** thick (14 gage).
 - 4. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- D. Supports and Anchors: Fabricated from not less than 0.042-inch thick (18 gage) electrolytic zinc-coated or metallic-coated steel sheet.
- E. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than **0.042-inch** thick (18 gage).
- F. Floor Anchors: Formed from same material as frames, not less than **0.042-inch** thick (18 gage), and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- G. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with standard steel frames, minimum **5/8-inch** high, unless otherwise indicated.

2.05 FABRICATION

- A. General: Fabricate steel frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Knock Down Frames: Flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor. Provide floor anchors for all frames.
 - 3. Jamb Anchors: Locate anchors not more than **18-inches** from top and bottom of frame. Space anchors not more than **32-inches** o.c. and as follows:
 - a. Stud-Wall Type:
 - 1) Three anchors per jamb up to **60-inches** in height.
 - 2) Four anchors per jamb from **60- to 90-inches** in height.
 - 3) Five anchors per jamb from **90- to 96-inches** in height.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each **24-inches** or fraction thereof more than **96-inches** in height.
 - 5) Two anchors per head for frames more than **42-inches** wide and mounted in metal-stud partitions.
 - 4. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - 5. Provide knock down frames with temporary spreader bars for shipping.
- D. Hardware Preparation: Factory prepare steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
 - 1. Reinforce frames to receive non-templated mortised and surface-mounted door hardware. Through bolting will not be acceptable.
 - 2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.07 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Apply primers to steel door and frames after assembly.

- B. Comply with SSPC-PA1, "Paint Application Specification No. 1," for steel sheet finishes.
- C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than **0.7 mils**.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

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 steel doors and frames.
 - 1. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation, adjust and securely brace steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus **1/16-inch**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus **1/16-inch**, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus **1/16-inch**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus **1/16-inch**, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Provide frames of sizes, thicknesses, and designs indicated. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Steel Frames: Install steel frames for doors and other openings, of size and profile indicated. Comply with SDI 105.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Remove shipping straps at bottom of frames. Properly space frame using wood template that is full depth of frame and of proper spacing width during setting and anchoring of frames to maintain proper width, with frame plumb and square without twists. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - c. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post installed expansion anchors. Floor anchors are in addition to wall anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Attach wall anchors to studs with screws. Provide floor anchor at each jamb, in addition to the wall anchors.
 - 4. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16-inch**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16-inch**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16-inch**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16-inch**, measured at jambs at floor.

3.04 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 081100

SECTION 083110 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawing 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. Wall access doors and frames.
 - 2. Fire-rated ceiling access doors and frames.
- B. Related Sections include the following:
 - 1. Division 22, 23, 26 Sections for heating and air-conditioning duct access doors.

1.03 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings for access doors and frames.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are labeled and listed by UL, or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 for vertical access doors.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.05 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, and surface defects; pickled and oiled; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M.
- C. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M. Electrolytic zinc-coated steel sheet, complying with ASTM A 591/A 591M, Class C coating, may be substituted at fabricator's option.
- D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304; with minimum sheet thickness indicated representing specified thickness according to ASTM A 480/A 480M.
- E. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- F. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.03 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.04 ACCESS DOORS AND FRAMES

- A. Fire-Rated Access Doors and Trimless Frames for Drywall: Flush, insulated units fabricated from steel sheet
 1. Locations: Gypsum board ceiling surfaces.
 2. Fire-Resistance Rating: 45 min. or 90 min; determined by construction rating access panel is mounted in.
 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch (20 gage).
 5. Frame: Minimum 0.060-inch thick (16 gage) sheet metal with drywall bead.
 6. Hinges: Concealed pin type or continuous piano hinge.
 7. Automatic Closer: Spring type.
 8. Latch: Self-latching bolt operated by flush screwdriver latch release ring or T-handle with interior release.
 9. Lock: Key-operated cylinder lock with interior release in locations accessible by the public.
 10. Size: 21-inches x 36-inches.
 11. Products:
 - a. J. L. Industries, Inc.; FDWB.
 - b. Karp Associates, Inc.; KRP-350 FR.

- c. The Williams Brothers Corporation of America; WB-FR Standard for drywall.
- B. Flush Access Doors and Trimless Frames: Fabricated from steel sheet, except as noted. Provide stainless steel sheet for units in walls within restrooms, toilet rooms, and janitor's closets and for units adjacent to sinks, water closets, urinals and similar fixtures that could cause fluids to come into contact with access door and frame.
- 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Door: Minimum 0.070-inch thick (14-gage) sheet metal, set flush with surrounding finish surfaces.
 - 3. Frame: Minimum 0.060-inch thick (16-gage) sheet metal with drywall bead.
 - 4. Hinges: Spring-loaded concealed pin type or continuous piano hinge (stainless steel for stainless steel units).
 - 5. Latch: Screwdriver-operated cam latch.
 - 6. Lock: Key-operated cylinder lock in locations accessible by the public.
 - 7. Products:
 - a. J. L. Industries, Inc.; Model WB.
 - b. Karp Associates, Inc.; Model KDW.
 - c. The Williams Brothers Corporation of America; WB-DW.
 - d. Provide comparable products where stainless steel units are required.

2.05 FABRICATION

- A. General: Provide access door assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. Provide mounting holes in frames to attach frames to metal or wood framing in drywall construction.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.06 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.07 STEEL FINISHES

- A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

2.08 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Bright, Directional Polish: No. 4 finish.
 - 1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.02 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install access doors with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.

3.03 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083110

SECTION 084110 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Exterior aluminum-framed storefronts.
 - a. Glazing is retained mechanically with gaskets on four sides.
 - 2. Exterior manual-swing aluminum doors.
 - 3. Exterior aluminum door frames.
 - 4. Break metal in conjunction with frames.
 - 5. Door hardware.
 - 6. Sealant at exterior perimeter of storefront.
 - 7. Interior aluminum storefront.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
 - 2. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
 - 3. Division 8 Section "Glazing" for glazing requirements to the extent not specified in this Section.
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Balance of door hardware furnished in Division 8 Section "Door Hardware".

1.03 PERFORMANCE REQUIREMENTS

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.

4. Dimensional tolerances of building frame and other adjacent construction.
 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.
- B. Structural Loads:
1. Wind Loads: As indicated on Drawings.
 2. Seismic Loads: As indicated on Drawings.
 3. Code: IBC 2006.
- C. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to **13-foot 6-inches** and to 1/240 of clear span plus **¼-inch** for spans greater than **13-foot 6-inches** or an amount that restricts edge deflection of individual glazing lites to **¾-inch**, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or **1/8- inch**, whichever is smaller.
- D. Structural Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Duration: As required by design wind velocity but not less than 10 seconds.
- E. Seismic Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of authorities having jurisdiction or ASCE 7-98, "Minimum Design Loads for Buildings and other Structures," Section 9, "Earthquake Loads," whichever are more stringent.
- F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of **0.06 cfm/sq. ft.** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **6.24 lbf/sq.ft.**
- H. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 283 at a minimum static-air-pressure difference of **6.24 lbf/sq. ft.**
- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than **0.44 btu/sq. ft. x h x deg F** when tested according to AAMA 1503.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 01330.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product installed.
 - 1. Submit replacement parts lists, adjustments instructions, and maintenance requirements for all components and hardware.
- C. Shop Drawings: For aluminum-framed systems, include plans, elevations, sections, details, and attachments to other work.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 - 3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
 - 4. Indicate fastener layout and size for transferring loads back to supporting structure.
- D. Samples:
 - 1. Factory-Applied Color Finishes: Submit manufacturers color charts in the form of prefinished aluminum samples, roughly **3- by 5-inches**, showing full range of colors available for each type of exposed finish indicated.
 - 2. Sealants: Manufacturers color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- E. Welding Certificates.
- F. Qualification Data: For Installer signed by manufacturer certifying that Installers comply with requirements in "Quality Assurance" Article.

- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.
- H. Inspection Reports: Manufacturers field service representative tests performed by a qualified testing agency, for aluminum-framed systems.
- I. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
 - 1. Include maintenance manuals for hardware provided in this Section.
- J. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

- A. Installer Qualification: Capable of assuming Engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including pre-construction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Source Limitations: Obtain each type of aluminum-framed entrance and storefront from one source and by a single manufacturer.
- D. Accessible Entrances: Comply with the US Architectural & Transportation Barriers Compliance Boards "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".
- E. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural welding Code-Aluminum".
- F. Pre-installation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Meetings." Review methods and procedures related to glazed aluminum storefront and entrance systems including, but not limited to, the following:
 - 1. Inspect and discuss condition of substrate and other preparatory work performed by

- other trades.
 - 2. Review structural loading limitations.
 - 3. Review and finalize construction schedule and verify availability of materials
Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review required inspecting, testing, and certifying procedures.
 - 5. Review weather and forecasted weather conditions and procedures for coping
with unfavorable conditions.
 - 6. Review temporary protection requirements for existing construction during
and after installation.
 - 7. Document proceedings, including corrective measures and actions required, and
furnished copy of record to each participant.
 - 8. Provide 72-hour minimum advance notice to participants prior to convening
pre-installation conference.
- G. Field Quality Control: Provide manufacturer's field services consisting of product use
recommendations and periodic site visits for inspection of product installation in accordance
with manufacturer's instruction. Upon completion of installation, manufacturer's field
representative shall prepare written report on installation of systems.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed
systems by field measurements before fabrication and indicate measurements on Shop
Drawings.
- 1. Coordinate rough opening and wood blocking requirements.

1.07 WARRANTY

- A. General: Special warranties specified in this Section shall not deprive Owner of other rights
Owner may have under provisions of Contract Documents and will be in addition to and run
concurrent with other warranties made by Contractor under requirements of Contract
Documents.
- B. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to
repair or replace components of aluminum-framed systems that do not comply with
requirements or that deteriorate as defined in this Section within specified warranty period.
- 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of system to meet performance requirements.
 - c. Noise or vibration caused by thermal movements.
 - d. Deterioration of metals, metal finishes, and other materials beyond
normal weathering.
 - e. Adhesive or cohesive sealant failures.
 - f. Water leakage through fixed glazing and framing areas.

- g. Failure of operating components to function properly.
 - h. Glazing breakage.
2. Warranty Period: Two (2) years from date of Substantial Completion.
- C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
- 1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
- 1. Kawneer Company, Inc.:
 - a. 1600 Wall System[™] 1 Curtain Wall Exterior
 - b. TRIFAB[™] Framing System
 - 2. Tubelite:
 - 3. YKK AP America, Inc.:

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308/M.
 - 5. Welding Rods and Bare Elements: AWS A5.10/A5.10M.
 - 6. Finish: Clear anodized.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC- COM and prepare surfaces according to applicable SSPC standard.
- 1. Structural Shapes, Plates and Bars: ASTM A 36/A 36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008/M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011/M.

2.03 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an Elastomeric material of low thermal conductance.
 2. Provide thermally broken extruded aluminum still flashing with end dams for windows.
 3. Provide non-thermally broken frames for interior units as noted on the drawings.
 4. Provide operable units (doors and windows) manufactured by storefront system manufacturer.
 5. Provide components having face width indicated on Drawings.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, non ferrous shims for aligning system components.
1. Provide extra-heavy reinforcement for hinges and closers at doors over **7-ft** in height.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce members as required to receive fastener threads.
 3. Do not use exposed fasteners, except for hardware application. For hardware applications, use exposed fasteners with countersunk Phillips screw heads, finished to match framing system or hardware being fastened, unless otherwise noted. Exposed fasteners shall be stainless steel.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123/M or ASTM A 153/A 153/M requirements.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
1. Provide vertical expansion joint flashing as detailed. Form flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- F. Aluminum Break Metal: Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness, not less than **0.060-inch** thick, to maintain a flat appearance without visible deflection.
- G. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.
1. Provide sealants and sealant primers for use inside of the weatherproofing system that comply with the following limits for VOC content when calculated according to South Coast Air Quality Management District Rule No. 1168.

- a. Sealant:
 - 1) Architectural 250 g/L.
 - 2) Other 420 g/L.
- b. Sealant Primer:
 - 1) Architectural, Non porous 250 g/L.
 - 2) Architectural, Porous 775 g/L.
 - 3) Other 750 g/L.

2.04 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, extruded EPDM rubber gaskets, fabricated to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- C. Spacers and Setting Blocks: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- D. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.
- E. Sealants and Joint Fillers: Provide for joints at perimeter of entrance and storefront systems as specified in Division 7 Section "Joint Sealants."

2.05 DOORS

- A. Doors: Manufacturer's standard glazed doors, for manual and power-assisted swing operation.
 - 1. Door Construction: 1¾-inch overall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Medium stile; 3½-inch nominal width, 10-inch high bottom rail, and 6-inch cross-rail.
 - 3. Door Frame: Minimum 0.188-inch thick extruded aluminum; 2-inch by 4½-inch profile, stop with weather-stripping; run heavy weight jambs full height of opening.
 - 4. Glazing Stops and Gaskets: Manufacturer's heavy weight removable mullion with weather-stripping, finish to match frame.
 - a. Provide non-removable glazing stops on outside of exterior doors.

2.06 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes, numbers, and types recommended by entrance system and hardware manufacturer for entrances and uses indicated. Finish exposed parts

to match door finish, unless otherwise indicated. Provide specified manufacturers without substitution.

1. Opening-Force Requirements:

- a. Egress Doors: Not more than **30 lbf** required to set door in motion and not more than **15 lbf** required to open door to minimum required width.
- b. Accessible Interior Doors: Not more than **5 lbf**.

B. Ball-Bearing Hinges:

1. Material: Stainless Steel.
2. Provide non-removable pins (NRP) at hinges exposed to outside of exterior doors and to non-secured side of interior doors.
3. Quantities:
 - a. For doors with heights up to **87-inches**, provide 3 hinges per leaf.
 - b. For doors with heights greater than 87-inches and up to **120-inches**, provide 4 hinges per leaf.

C. Removable Hardware Mullion Meeting Stile: BHMA A156.3; steel painted to match storefront. Provide at exterior doors with weather-stripping.

1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

D. Weather-stripping: Manufacturer's standard exterior door bottom sweep with concealed fasteners on mounting strip.

E. Weather Sweeps: Manufacturer's standard exterior door bottom sweep with concealed fasteners on mounting strip.

F. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of **1/2-inch**. Coordinate cutouts for operating hardware with anchors and jamb clips. Provide with a maximum slope of not more than 1:2.

1. Material: Aluminum, mill finish.

G. Balance of Hardware: See Division 8 "Door Hardware".

2.07 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC=Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.08 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove welding spatter and welding oxides from exposed surfaces by de-scaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge of clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without project stops).
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
 - 1. At exterior doors, provide compression weather-stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install 3 silencers on strike jamb of single-door frames and 2 silencers on head of frames for pairs of doors.
- F. Entrance Doors: Reinforce doors as required for installing hardware.
 - 1. At exterior doors, provide weather sweeps applied to door bottoms and compression weather-stripping at fixed stops.
- G. Windows: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact. Fabricate units that are re-glazable without dismantling sash or ventilator framing.
 - 1. Provide hardware with low conductivity or non-metallic material for hardware bridging thermal breaks at frame.

- H. Entrance Door Hardware Installation: Factory-install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed and field-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.09 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA; comply with the system established by the Aluminum Association for designing aluminum finishes.
- C. High-Performance Organic Finish (2 Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish; conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and Fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturer's written instructions.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure non-movement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight, unless otherwise indicated.
- B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing non-conductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation. Install sills in one piece, full width of opening except where opening exceeds available manufactured lengths. Provide sealed metal end dams at ends of sills. Sills shall turn up on backside to form pan, directing water to the exterior.
- E. Install components plumb and true in alignment with established lines and grades, without warp or rack.
- F. Install glazing as specified in Division 8 Section "Glazing".
- G. Entrance Doors and Windows: Install to produce smooth operation and tight fit at contact points.
1. Exterior Entrances and Windows: Install to produce tight fit at weather-stripping and weathertight closure.
 2. Field-installed Hardware: Install surface-mounted hardware according to hardware manufacturers written instructions using concealed fasteners to greatest extent possible.
 3. Install hardware furnished in Division 8 Section "Door Hardware".
- H. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to product weathertight installation. Color of sealant to match aluminum finish.
- I. Erection Tolerances: Install aluminum-framed systems to comply with following maximum tolerances:
1. Location and Plane: Limit variation from true location and plane to **1/8-inch** in **12-feet**; **1/4-inch** over total length.
 2. Alignments:
 - a. Where surfaces abut in line, limit offset from true alignment to **1/16-inch**.
 - b. Where surfaces meet at corners, limit offset from true alignments to **1/32-inch**.
 3. Diagonal Measurements: Limit difference between diagonal measurement to **1/8-inch**.

3.03 ADJUSTING AND CLEANING

- A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures entrances and storefront systems are without damage or deterioration

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

at time of Substantial Completion.

END OF SECTION

SECTION 087100 – FINISH HARDWARE, ACCESS CONTROL, LOW VOLTAGE WIRING

PART 1 –GENERAL

1.01 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.02 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Providing hardware for all doors, except doors provided with their own hardware.
 - 2. Providing lock cylinders for all work requiring cylinders.
 - 3. Providing the services of a qualified hardware consultant to prepare detailed schedules of hardware required for the project.
 - 4. Provide all low voltage wire and wiring for access control system. Locate card access controller in Work Room 117.

1.03 RELATED WORK

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
 - 1. Section 08100 – Hollow Metal Doors and Frames; work requiring template coordination, metal astragals for fire-rated doors.
 - 2. Section 08210 – Wood Doors; work requiring template coordination, metal astragals for fire-rated doors.
 - 3. Division 26 – Electrical conduit and raceways.

1.04 INTENT

- A. A major intent of the work of this section is to provide hardware for every door in the project, except as indicated, so that each door functions correctly for its intended use. Provide only hardware that complies with applicable codes and requirements of authorities having jurisdiction including requirements for barrier-free accessibility.

1.05 QUALITY ASSURANCE

- A. Hardware supplier shall have in his employ one or more members of the Door and Hardware Institute to include at least one Certified Architectural Hardware Consultant in good standing, who shall be responsible for preparation of the Finish Hardware Schedule. This Consultant shall be acceptable to the Architect and is to ensure that the intent requirement of this specification is fulfilled, and certify that the work of this section meets or exceeds the requirements specified in this section and the requirements of authorities having jurisdiction.

- B. Hardware supplier shall warrant and guarantee, in writing, that hardware supplied is free of defective material and workmanship. Supplier shall further warrant and guarantee for a period of one year from Owner's Use and Occupancy that the hardware shall function in a satisfactory manner without binding, collapse, or dislodging of its parts, provide the installation is made to the manufacturer's recommendations.
- C. The hardware supplier shall repair or remedy, without charge, any defect of workmanship or material for which he is responsible hereunder.

1.06 SUBMITTALS

- A. Submit the following in accordance with SECTION 01300-SUBMITTALS:
 - 1. Schedule: Submit to the Architect six (6) copies of the complete hardware schedule within the fourteen (14) days after receipt of contract award. Submit therewith complete catalog cuts and descriptive data of all products specifically scheduled therein. No materials shall be ordered or templates issued until the hardware schedule has been approved by the Architect. Form and detail of hardware schedule shall be in vertical format in conformance to the door and hardware industry standards. All hardware sets shall be clearly cross-referenced to the hardware set numbers listed in the specifications.
 - 2. Samples: If requested, submit to the Architect for approval, a complete line of samples as directed. Samples shall be plainly marked giving hardware number used in this specification, the manufacturer's numbers, types and sizes. The Architect will deliver approved samples to the project site to be stored. Samples will remain with the Architect until delivery of all hardware to the project is complete, after which time they will be turned over to the General Contractor for incorporation into the work.
 - 3. Keying System Submission: Before cylinders are ordered, submit a complete proposed keying system for approval. This should be done after a keying meeting has been held with the owner's representative.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of hardware shall be made to the project by the Hardware Supplier in accordance with the instructions of the General Contractor.
- B. The finish hardware shall be delivered to the jobsite and received there by the General Contractor. The General Contractor shall prepare a locked storage room with adequate shelving, for all hardware. The storage room shall be in a dry, secure area, and shall not include storage of other products by other trades.

- C. The General Contractor shall furnish the Hardware Supplier with receipts for all hardware and accessory items received, and shall send copies of these receipts to the Architect, if requested.

1.08 REGULATORY REQUIREMENTS

- A. Conform to all applicable codes. Provide all throws, projections, coatings, knurling, opening and closing forces, and other special functions required by State and Local Building Codes, and all applicable Handicap Code requirements.
- B. For fire rated openings, provide hardware complying with NFPA 80 and NFPA 101 without exception. Provide only hardware tested by UL for the type and size of door installed and fire resistance rating required.

1.09 SPECIAL REQUIREMENTS

- A. Hardware Supplier shall determine conditions and materials of all doors and frames for proper application of hardware.
- B. The Hardware Schedule shall list the actual product series numbers. Bidders are required to follow the manufacturers' catalog requirement for the actual size of door closers, brackets and holders. All door opening sizes are as noted on the Door Schedule and all hardware shall be in strict accordance with requirements of height, width, and thickness.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Hinges	McKinney Stanley	Scranton, PA New Britain, CT
Locksets	Schlage Sargent	Colorado Springs, CO New Haven, CT
Exit Devices	Sargent Von Duprin	New Haven, CT Indianapolis, IN
Door Closers	Sargent LCN	New Haven, CT Princeton, IL
Door Stop	Glynn Johnson Ives Rockwood	Indianapolis, IN New Haven, CT Rockwood, PA
Card Access System	Sielox	Runnemede, NJ
Push/Pulls	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Protective Plates	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Thresholds/ Weatherstripping/ Rain Drips	NGP Pemko Reese	Memphis, TN Memphis, TN Rosemount, MN
Silencers	Ives Glynn Johnson Rockwood	New Haven, CT Indianapolis, IN Rockwood, PA

2.02 MATERIALS AND QUALITY

- A. All hardware shall be of the best grade of solid metal entirely free from imperfections manufacturer and finish.
- B. Qualities, weights, and sizes given herein are the minimum that will be accepted. It is the responsibility of the Hardware Supplier to supply the specified size and weight of hardware and the proper function of hardware in each case and to provide UL approved hardware at all fire rated doors.

- C. Provide, as far as possible, locks of one lock manufacturer and hinges of one hinge manufacturer. Modifications to hardware that are necessary to conform to construction shown or specified shall be provided as required for the specified operation and functional features.

2.03 HARDWARE DESIGNATIONS

- A. All items of hardware are referenced by manufacturer's names and numbers. The manufacturer's names and numbers are used to define the function, design, and the quality of the material to be supplied.

Substitution of products other than those listed shall be submitted to the Architect at least ten (10) days PRIOR to the bid date. The Architect shall be the sole judge of any proposed substitution.

2.04 TEMPLATES

- A. Hardware supplier shall immediately, but not later than three (3) days after approval of his Schedule by the Architect, furnish the General Contractor with complete template information necessary for the fabrication of doors, frames, etc. No templates shall be furnished prior to the approval of the hardware schedule.

2.05 HARDWARE FOR LABELED FIRE DOORS, EXIT DEVICES AND SMOKE DOORS

- A. Hardware shall conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Labeling and listing by UL Building Materials Directory, for class of door being used will be accepted as evidence of conformance to these requirements. Install minimum latch throw as specified on label of individual doors. Provide hardware listed by UL except where heavier materials, larger sizes, or better grades are specified herein under paragraph entitled "Hardware Sets". In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements. Specific hardware requirements of door or frame manufacturers which exceed sized or weights of hardware herein listed shall be provided with no additional charge.

2.06 KEYS AND KEYING

- A. The hardware supplier shall review the specific hardware functions with the Architect and owner at the time of the keying review, to assure the appropriateness of each of the hardware functions. Failure to make this review does not relieve the hardware supplier from providing the proper functions.

- B. Key System: All cylinders shall be Masterkeyed and/or Grandmaster Keys: Furnish six (6) keys for each set, if required.
1. Master keys, Grandmaster Keys: Furnish six (6) keys for each set, if required.
 2. Furnish three (3) change keys for each cylinder keyed differently; six (6) change keys for each set keyed alike, and in sets where only (2) cylinders are keyed alike, four (4) change keys will be required.
 3. All keying is to be done at the factory to avoid duplication of the new cylinders.
 4. Master Keys shall be sent to the Owner by registered mail, return receipt required.
 5. Supply a bitting list for all change keys and master keys to the Owner.
 6. All lock cylinders shall be set to Construction key for use by the Contractor during the construction period. Furnish ten (10) Construction keys and two (2) voiding the Construction key feature.

2.07 FASTENERS

- A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation.
- B. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish exposed screws to match the hardware finish, or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, except as otherwise indicated.
- C. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do not use thru-bolts unless specifically approved by the Architect.
- D. All hardware shall be installed only with fasteners supplied by manufacturers of specific products.

2.08 PACKING AND MARKING

- A. All hardware shall have the required screws, bolts and fastenings necessary for proper installation and shall be wrapped in the same package as the hardware item for which it is intended and shall match finish of hardware with which to be used.
- B. Each package shall be clearly labeled indicating the portion of the work for which it is intended.

2.09 ENVIROMENTAL CONCERN FOR PACKING

- A. The hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of Styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-degradable packing.

2.10 FINISH HARDWARE DESCRIPTION

- A. Hardware items shall conform to respective specifications and standards and to requirements specified herein.

B. MATERIALS AND FINISH MATERIALS AND FINISHES SHALL BE:

- 1. Interior Butts: US26D (BHMA 652)
- 2. Exterior Geared Hinges US28 (BHMA 628)
- 3. Door Closers: Sprayed to match hardware finish.
- 4. Exit Devices: US26D (BHMA 626)
- 5. Kick, Push Plates: US32D (BHMA 630)
- 6. All other hardware shall be: US26D (BHMA 626), or as scheduled.

C. HINGES

- 1. Number of hinges per door, two hinges for doors up to and including five feet in height and an additional hinge for each two and one half feet or fraction thereof.
- 2. Hinges shall be as follows:

Exterior	McKinney	TA2314	4 ½ x 4 ½ NRP
	Stanley	FBB191	4 ½ x 4 ½ NRP
Interior	McKinney	TA2714	4 ½ x 4 ½
	Stanley	FBB179	4 ½ x 4 ½
Elec	McKinney	TA2714-CC8	
	Stanley	CEFBB179	

D. DOOR CLOSERS:

- 1. Door closers shall have fully hydraulic, full rack and pinion action. Cylinder body shall be 1-1/2” in diameter, and double heat treated pinion shall be 11/16” in diameter.
- 2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

3. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and hydraulic back-check.
4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).
5. Closer arms (and metal covers when specified) shall have a powder coating finish.
6. Provide drop, mounting plates, where required.
7. Do not locate closers on the side of doors facing corridors, passageways or similar type areas. Where it is necessary, due to certain conditions and approval of the Architect, to have closers in corridors, provide such closers with parallel or track type arms.
8. All door closers shall be adjusted by the installer in accordance with the manufacturer's templates and written instructions. Closers with parallel arms shall have back-check features adjusted prior to installation.
9. Closers shall conform to all applicable code requirements relative to setting closing speeds for closers and maximum pressure for operating interior and exterior doors.
10. Door closers meeting this specification are as follows:

	LCN	Sargent
Exterior	4111S-CUSH	281 – CPS
	4111S-H-CUSH	281 – CPSH
Interior	4011	281- 0
	4111	281 – P10
	4040SE	2407 Series
	4000T	281 – OT x spec. TEMP.
	4310ME-SF	2980
	4040SE-DE	2477

E. EXIT DEVICES:

1. Shall be Von Duprin or Sargent as follows:

Function	Von Duprin	Sargent
A	CD99NL-OP	16-8804
B	99EO	8810
C	99L-2	8813ET
D	99L-BE	8815ET
E	99NL-F	12-8804
F	99L-F	12-8813ET
G	99L-F-BE	12-8815ET
H	9927EO	8710
I	9927L	8713ET
J	9927L-BE	8715ET
K	CD9927EO x LBR	16-PP/PR8710
L	9927L x LBR	PP/PR8713ET
M	9927L-BE x LBR	PP/PR8715ET
N	CD99271F	CD8710 x 306
O	9927L-F	12-8713ET
P	9927L-F-BE	12-8715ET
Q	9927EO-F x LBR	12-PP/PR8710
R	9927L-F x LBR	12-PP/PR8713ET
S	9927L-F-BE x LBR	12PP/PR8715ET
T	EL9927TP	56-8710 x 306
U	EL99L-F	55 56-12 8813 ETL
V	EL99NL-OP	55 56-8804
W	EL9927EO	55 56 8710

NOTE: Lever design shall match lock trim

F. HEAVY DUTY LEVER HANDLE CYLINDRICAL LOCKS:

1. Locksets for this project shall be heavy duty cylindrical key-in-lever handle type locksets.
2. Locksets shall be 2 ¾" backset with ½" throw latchbolt, with deadlocking latch, and a cylindrical housing of steel with a zinc dichromate finish.
3. Locksets shall be fastened by thru-bolts, thru the 3 ½" diameter inside rose back plate into the threaded studs in the outside rose back plate. Thru-bolts shall be placed in separate bolt holes, thru the door and outside the cylindrical case at 180 deg. from each other.
4. The inside and outside rose scalps shall be 3 ½"diameter wrought brass or bronze. When assembled, all thru-bolts in the face of the door shall be concealed from view. The lever handles shall be solid cast in the same finish as the rose.

5. The ½' throw latchbolt shall be listed and approved for use by Underwriters Laboratories.
6. Strikes shall be curved lip ANSI A115.2 4 7/8" x 1 ¼" wrought brass or bronze.
7. The following locksets shall be considered acceptable for this project:

Schlage	"ND" Series	RHO Design
Sargent	10 Line	LL Design

8. Lock functions as indicated in the hardware schedule shall be as follows:

Function	Schlage	Sargent
A(Storeroom)	80	04
B(Storeroom)	80 (Knurled)	04
C(Office)	50	05
D(Passage)	10	15
E(Vestibule)	60	16
F(Classroom)	70	37
G(Spec Classroom)	71	38
H(Privacy)	40	65
I(Dummy)	170	93
J(Electric Lock)	EU-REX	71 RX
K(Key Pad)		KP10G77

G. PUSH PLATES, DOOR PULLS, PUSH/PULL BARS:

1. Shall be as manufactured by Rockwood, Burns or Ives.
 - a. Push plates shall be 4" x 16" x .050 thickness unless otherwise listed in hardware sets.

Rockwood	70 Series
Burns	50 Series
Quality	40 Series

- b. Door pulls shall be 1" x 10"

Type A

Rockwood	BF111
Burns	BF26C
Quality	BF163-10"

c. Push/pull bars

Type A (Wide Stile Doors)

Rockwood	BF11147 x T1006 Mounting
Burns	BF26C x 442 x Sim. Mounting as Above
Quality	BF 482 x Sim. Mounting as Above

H. KICK PLATES, ARMOR PLATES, MOP PLATES:

1. Kick plates shall be 8 in. high. Armor plates shall be 34 in. high. Mop plates shall be 4 in. high. All plates shall be 2 in. less the width of door. Plates shall be .050 thickness, bevel 4 edges, screws shall be oval head counter-sunk.

I. STOPS

1. Shall be furnished at all doors. Wherever an opened door or any item of hardware thereon strikes a wall, at 90 degrees. Provide wall bumpers, unless otherwise indicated in hardware sets.
2. Where wall bumpers cannot be effectively used, a floor stop shall be furnished and installed.
3. Provide roller bumpers for each door where two doors interfere with each other in swinging.

Manufacturer	Wall Bumpers	Floor Stops	Roller Bumpers
Rockwood	409	440, 442	456
Ives	407 ½	436B, 438B	470 Series
Glynn Johnson	WB 50XT	FB13, FB14	RB-3

4. Where overhead stops are listed they shall be the surface mounted type as follows:

Manufacturer	Series
Glynn Johnson	GJ450
Sargent	1540
ABH	4400

J. THRESHOLDS, WEATHERSTRIP, SEAL:

1. Thresholds shall be as detailed and furnished on all doors where shown on drawings. Thresholds shall be aluminum unless otherwise indicated. Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants".
2. Weatherstripping shall be furnished on all exterior doors unless otherwise indicated.

Product	Pemko	NGP
Threshold	as detailed	
Brush Seal	45062AP	A626A
Auto. Door Bottom	430CR	420
Door Sweep	345AV	101AV
Set Astragals	351C x 351CP	140 x 140P
Astragal	357SP	139SP
Rain Drip	346C	16A

K. POWER SUPPLY:

Provide Securitron BPS0 power supply or Von Duprin PS873.

L. LOW-ENERGY OPERATOR:

Provide Horton 4100LE low energy operator. Push button switches to be wireless type radio control unit. Provide MC-25 interface switch for all operators with card access control.

M. ACCESS CONTROL SYSTEM

A. Approved Manufacturers:

1. Sielox

B. This document includes a general description, functional requirements, characteristics, and criteria for the Access Control System (ACS).

C. This specification provides information necessary to produce a complete proposal for a sophisticated, easy-to-use software, intelligent field advanced processing controller, communication devices, card readers/keypads, access cards, I/O boards, power supplies, conduit, raceways, enclosures, mounting hardware, and all other equipment as indicated on the contract drawings if supplied and as specified herein. All material shall be the manufacturer's standard catalog products.

- D. This document provides the information necessary to produce a complete proposal for a highly secure, easy-to-use and dependable Access Control System (ACS). The ACS shall provide the speed and flexibility of 32-bit multiple-technology controllers and be managed by a client/WEB Client/server/application using an intuitive graphical operator interface on the Microsoft Windows 2003, 2005, Vista, or XP PRO operating system. The ACS shall include all computer hardware and software, field controllers, communication boards, power supplies, conduit if applicable, raceways if applicable, and all other equipment as indicated and as specified herein. All material shall be the manufacturer's standard catalog products. All products are to be NEW.
- E. The ACS shall be a 32-bit native Microsoft Windows 2003, 2005, Vista, or XP PRO application with multi-operator and multi-threaded (multi-tasking) capability, allowing independent activities and monitoring to occur simultaneously at different locations. Full WEB based or Hosted Access Control Systems are not acceptable.
- F. The WEB Client workstation shall be easy to use and employ intuitive icon based operator interface.
- G. The ACS shall be designed with the ability to expand as the project needs grow.
- H. The ACS shall be simple and economical enough to support a single site, yet powerful and flexible enough to manage a multiple-site network.
- I. ACS shall operate in a WEB client/server/ (or client/database server to hardware server) configuration on high-quality Pentium processor personal computers running Microsoft Windows 2003, 2005, Vista, or XP PRO operating system and Microsoft SQL/MSDE database.
- J. The software shall be designed to support the manufacturer's past & present generation access control hardware and additional OEM components.
- K. The ACS shall allow ODBC database access either through a defined ODBC interface or an SDK library set
- L. The ACS shall conform to standard networking protocols, including: Ethernet, TCP/IP (Ethernet) and NetBEUI.
- M. Any workstation shall have the ability to display up to four independently configured viewers, each with its own title, filter, columns, and optional cardholder image display.
- N. All core ACS hardware and software shall be developed and manufactured by the same manufacturer.

- O. System must provide full WEB client capabilities and supporting any WEB browser, such as Internet Explorer, Safari, Firefox, etc. Security for the WEB Client must be at a minimum 256-bit AES encryption.

- P. System Software and AC Controllers must support the following features:
Systems that do not support these features will not be accepted as an alternative.
 - 1. First Person rule for automatic unlocks/lock with multiple time intervals
 - 2. Email on Alarms or any event driven action
 - 3. Unlimited Access groups
 - 4. Unlimited Time Zones each with eight intervals each
 - 5. Minimum of 2,000 users per Access Control Controller
 - 6. 32 Holidays'
 - 7. Password Protected Administrators and Unlimited configurations for operators
 - 8. Minimum 200 standard reports
 - 9. Auto Database backup
 - 10. Minimum 99 Alarm Levels with full detailed response description with audio
 - 11. Auto Activation and Expiration for users
 - 12. Time and Attendance Interface
 - 13. Individual Expiring Access Levels per Card Holder
 - 14. System must have a optional System Developer Kit or API
 - 15. Unlimited Cardholder Custom Fields with minimum of 256 characters
 - 16. Local, Regional, and Global input/output linking
 - 17. Event filtering with email capabilities
 - 18. Scheduler for recurring functions i.e. auto door unlocks and auto lock, reports, building lighting control, etc.
 - 19. Access Control Manufacture must be in business a minimum 15 years manufacturing access control controllers, software, and readers
 - 20. System is required to support 64 access points for expansion and 2,568 inputs/outputs
 - 21. Each access control door controller must hold at minimum 10,000 transactions in its on-board data storage without communication to the host
 - 22. Access control controllers must be of the two door type controllers for ease of expansion and cost. Systems that utilize a master controller with door expansions from the master system/controller will not be accepted.
 - 23. All door controllers need to be Distributed Processing with real time clock on board each controller with battery back-up for memory for a period of 3 months. In addition to memory back-up Controllers are to support at minimum two hours of complete operation in the event of a power outage.
 - 24. System must be able to provide Muster Reports
 - 25. Controllers need to be UL 294 and 1076 or ETL Certified to the UL Listing. Controllers not providing this listing will not be accepted

26. Controllers need to accept TCP/IP communication directly to the controller
27. Anti-pass back
28. Secure communications via 3DES, 168-bit encryption
29. The ACS shall provide interactive on-line help with extensive on-line manual. The on-line manual shall be available to allow the operator to obtain detailed help without having to consult a manual.
30. N-Man rule for counting card holders in a protected area

Q. Access Control Controllers:

1. The controllers shall be capable of communicating to the host computer using the following communications options:
 - a. LAN/WAN networking
 - b. RS-485
 - c. Dial-up Modem
2. All database information shall be stored at the controller level resulting in decision making being performed at the controller level thus reducing degraded mode operation.
3. Controllers shall support direct wiring of a Wiegand output reader without the need for a separate reader interface board.
4. Controllers shall be compatible with any identification device that transmits data using Wiegand, clock/data, or other industry standard protocol. This shall include but not limited to proximity, bar code, magnetic stripe, Wiegand, keypads and biometric readers.
5. 10 Base-T, 100 Base-T, or 10/100 Base-T communications.
6. Web-based diagnostics for IP controller analysis from any networked computer
7. The ACS shall support proximity card, Wiegand, magnetic stripe, and barcode technologies

R. Readers: Provide Proximity type readers with read range of 3 to 5 inch:

1. Approved Manufacturers:
 - a. HID
 - b. AWID
 - c. Exceed ID

S. Field Quality Control

1. Installation

- a. The contractor shall install all system components and appurtenances in accordance with the manufacturer's instructions, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation. Provide mounting hardware as required.
- b. Coordinate wiring of controlled or monitored doors with owner
- c. All low voltage wiring outside the control console, cabinets, boxes, and similar enclosures, shall be plenum rated where required by code. Cable shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring.
- d. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors. All communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors, except fiber optics, which serve as communications circuits from security console to field equipment, and between field equipment, shall have surge protection circuits installed at each end.
- e. All boxes and enclosures containing security system components and/or cabling and which are easily accessible to employees or to the public shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible.
- f. All junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamper proof screws.
- g. All exposed metallic flexible conduit and armored cable shall be dressed down neatly and secured with low profile, metal fasteners.
- h. End-of-Line resistors shall be installed at the field device location and/or at the controller panel location.
- i. ACS device locations on floor plans are intended to generally indicate areas where such devices are to be located. Security Contractor and CPORT Credit Union will be responsible for determining final location of these devices in accordance with Owner's requirements.

- j. Provide such materials as necessary for a complete and functioning installation. Install in accordance with referenced codes and these specifications. Use weatherproof equipment or covers where installed in areas exposed to weather.
- k. Seal penetrations through fire rated construction in accordance with draft stop penetrations in all partitions not required to be fire stopped. Draft stop material shall be pliable and elastic, similar to Dow Corning silicone sealant.
- l. Product data submitted shall include manufacturer's documentation that specifically states which circuits are power-limited in accordance with NEC Article 725.
- m. Protect cable from damage when passing through building structure or conduit system. Provide sleeves wherever cable penetrates floors or partitions; for sleeves. Provide conduit stubs where wiring runs inside walls or partitions. Provide bushings wherever cable enters sleeves, conduit, junction boxes, equipment backboxes, or control enclosures. Install cable in conduit where it would otherwise be exposed, as in mechanical and electrical equipment rooms.

N. OCCUPANCY INDICATOR DEADBOLT

- A. Equal to Arrow model E50

PART 3—EXECUTION

3.01. INSPECTION

1. It shall be the general contractors responsibility to inspect all doors openings and doors to determine that each door and door frame has been properly prepared for the required hardware. If errors in dimensions or preparation are encountered, they are to be corrected by the responsible parties prior to the installation of hardware.

3.02 PREPARATION

1. All doors and frames, requiring field preparation for finish hardware, shall be carefully mortised, drilled for pilot holes, or tapped for machine screws for all items of finish hardware in accordance with the manufacturers templates and instructions.

3.03 INSTALLATION/ADJUSTMENT/LOCATION

1. All materials shall be installed in a workmanlike manner following the manufacture's recommended instructions.
2. Exit Devices shall be carefully installed so as to permit friction free operation of crossbar, touch bar, lever. Latching mechanism shall also operate freely without friction or binding.
3. Door Closers shall be installed in accordance with the manufacturer's instructions. Each door closer shall be carefully installed, on each door, at the degree of opening indicated on the hardware schedule. Arm position shall be shown on the instruction sheets and required by the finish hardware schedule.
4. The adjustments for all door closers shall be the installer's responsibility and these adjustments shall be made at the time of installation of the door closer. The closing speed and the latching speed valves, shall be adjusted individually to provide a smooth, continuous closing action without slamming. The delayed action feature or back check valve shall also be adjusted so as to permit the correct delayed action cycle or hydraulic back check valve shall also be adjusted so as the opening cycle. All valves must be properly adjusted at the time of installation. Each door closer has adjustable spring power capable of being adjusted, in the field from size 2 thru 6. It shall be the installers' responsibility to adjust the spring power for each door closer in exact accordance with the spring power adjustment chart illustrated in the door closer installation sheet packed with each door closed.
5. Installation of all other hardware, including locksets, push-pull latches, overhead holders, door stops, plates and other items, shall be carefully coordinated with the hardware schedule and the manufacturer's instruction sheets.

6. Locations for finish hardware shall be in accordance with dimensions listed in the pamphlet "Recommended locations for Builders' Hardware" published by the Door and Hardware Institute.

3.04 FIELD QUALITY CONTROL

1. Upon completion of the installation of the finish hardware, it shall be the responsibility of the finish hardware supplier to visit the project and to examine the hardware for each door on which he has provided hardware and to verify that all hardware is in proper working order. Should he find items of hardware not operating properly he should make a report, in writing, to the general contractor, advising him of the problem and the measures required to correct the problem.

3.05 PROTECTION

1. All exposed portions of finish hardware shall be carefully protected, by use of cloth, adhesive backed paper or other materials, immediately after installation of the hardware item on the door. The finish shall remain protected until completion of the project. Prior to acceptance of the project by the Architect and owner, the general contractor shall remove the protective material exposing the finish hardware.

3.06 CLEANING

1. It shall be the responsibility of the general contractor to clean all items of finish hardware and to remove any remaining pieces of protective materials and labels.

3.07 INSTRUCTIONS AND TOOLS

1. It shall be the responsibility of the finish hardware supplier to provide installation and repair manuals and adjusting tools, wrenches, etc... for the following operating products.
 - a. Locksets (all types)
 - b. Exit Devices (all types)
 - c. Door Closers

3.08 HARDWARE SETS

1. Each Hardware Set listed below represents the complete hardware requirements for one opening. (Single Door or Pair of Doors). Furnish the quantities required for each set for the work.

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Windows.
 2. Doors.
 3. Glazed entrances.
 4. Interior borrowed lites.
 5. Storefront framing.
 6. Silvered mirrored glass.

1.2 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction. Apply sun guard to glass surface as noted, or required.

- B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements or as indicated in the glazing schedules:
 - a. Specified Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade indicated on Drawings.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 60 seconds or less.
 - c. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.
 - 1) For monolithic-glass lites heat treated to resist wind loads.
 - 2) For insulating glass.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Shop Drawings: Provide shop drawing showing pattern for decorative glass.
- C. Glazing Schedule: Use same designations indicated in this section for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Insulating Glass: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- E. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
- F. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
- G. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
- H. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
- I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
 - 1. Insulating Glass Certification Council.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.8 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRIMARY FLOAT GLASS

- A. Clear Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); Class 1 (clear), 1/4 inch (6 mm) thick.

2.2 HEAT-TREATED FLOAT GLASS - SG1

- A. Fabrication Process: Kiln-Cast, customer textured one off molds as manufactured by Meltdown Glass Art and Design.
- B. Tempered Float Glass: ASTM C 1048; fully tempered with laminations meeting ASTM C 1172.

- C. Tempered Patterned Glass: Texture MD-202 Flow, 3/8-inch thick clear, fused dichroic multi-colored class.
 - 1. Provide for installation as noted on the drawings.

2.3 INSULATING GLASS

- A. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article.
 - 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
 - 2. Provide Kind FT (fully tempered) where safety glass or tinted glass is indicated.
- B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in this article are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
- C. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - 1. Polyisobutylene and silicone.
 - 2. Comply with LEED Low-Emitting materials: adhesives and sealants.
- D. Spacer Specifications: Manufacturer's standard spacer material and construction.
- E. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - 1. Aluminum with mill or clear-anodized finish.
 - 2. Desiccant: Molecular sieve or silica gel, or blend of both.
 - 3. Corner Construction: Manufacturer's standard corner construction.
- F. Low-E Insulating Glass: Where glass of this designation is indicated, provide low-Emissivity insulating-glass units complying with the following: Vitro
 - 1. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm. 1" insulating glass with 2 pieces of 1/4" glass and 1/2" air space.
 - 2. Interspace Content: Air .28 U value.
 - 3. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
 - 4. Outdoor Lite: Type I (transparent glass, flat) Class 1 (clear) float glass.
 - 5. Low-Emissivity Coating: Solarban 70XL Optigray.
 - 6. Application: Exterior aluminum entrances, storefronts and curtainwall.
 - 7. Fully Tempered where required by code and where indicated.
 - 8. VLT = 47%
 - 9. SHGC = .24
 - 10. LSG = 1.96
 - 11. Exterior Reflectance: 8%
 - 12. Interior Reflectance: 12%

2.4 MIRRORED GLASS

- A. Silvered Mirrored Glass: Float glass with successive layers of chemically deposited silver, electrically or chemically deposited copper, and manufacturer's standard organic protective coating applied to second glass surface to produce a coating system complying with ASTM C1036 and CPSC 16 CFR 1201, 1/4 inch (6mm) thick.
 - 1. Safety Backing Film: Provide safety backing film or tape by C.R. Laurence Company, Inc. or approved substitute to provide safety compliance with ANSI Z97.1-84.
- B. Mirrored Glass Edge Treatment: Beveled polished edge.

2.5 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range for this characteristic.
 - 4. Comply with LEED Low-Emitting materials: adhesives and sealants.
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
 - 1. Additional Movement Capability: Where additional movement capability is specified in the Glazing Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements in ASTM C 920 for uses indicated.
 - 2. Comply with LEED Low-Emitting materials: adhesives and sealants.
- C. Low-Modulus Nonacid-Curing Silicone Glazing Sealant: Where glazing sealants of this designation are indicated, provide products complying with the following:
 - 1. Products: Available products include the following:
 - a. 790; Dow Corning.
 - b. Silpruf; GE Silicones.
 - c. 864; Pecora Corporation.
 - d. Omniseal; Sonneborn, Div of ChemRex, Inc.
 - e. Spectrem 1; Tremco.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
 - 5. Applications: Wet sealant installations.

6. Comply with LEED Low-Emitting materials: adhesives and sealants.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based Elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
 3. Comply with LEED low emitting materials.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Mirror Mastic: An adhesive setting compound, produced specifically for setting mirrored glass by spot application, certified by both mirrored glass manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrored glass will be installed.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Gunther Mirror Mastics.
 - b. Palmer Products Corporation.

2.8 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of Elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of Elastomeric sealant over exposed edge of tape.
- I. Comply with LEED low emitting materials.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 MIRRORS

- A. Mastic Spot Installation System: Install mirrored glass units with mastic as follows:
 - 1. Apply barrier coat to mirrored glass backing where approved in writing by manufacturers of mirrored glass and backing material.
 - 2. Apply mastic in spots to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrored glass units and face of mounting surface.
 - 3. After mastic is applied, align mirrored glass units and press into place while maintaining a minimum air space of 1/8 inch between back of mirrored glass and mounting surface.

3.7 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION

SECTION 089110 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Conventionally glazed aluminum curtain walls installed as stick systems.
 - 2. Break metal in conjunction with frames.
 - 3. Sealant at interior and exterior perimeter of curtain wall.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain-wall systems and for sealants to the extent not specified in this Section.
 - 2. Division 8 Section "Aluminum-Framed Entrances and Storefronts" for entrance and storefront systems.
 - 3. Division 8 Section "Glazing" for insulating-glass requirements.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 4. Dimensional tolerances of building frame and other adjacent construction.
 - 5. Failure includes the following:
 - a. Air infiltration and water penetration exceeding specified limits.
 - b. Deflection exceeding specified limits.
 - c. Thermal stresses transferred to building structure.
 - d. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - e. Noise or vibration created by wind and thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
- B. Glazing is physically and thermally isolated from framing members.
- C. System is pressure equalized at its interior face.
- D. System is reglazable from the exterior.
- E. Structural Loads:

1. Wind Loads: As indicated on Drawings.
 2. Seismic Loads: As indicated on Drawings.
 3. Code: IBC 2003.
- F. Structural-Test Performance: Provide glazed aluminum curtain-wall systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Duration: As required by design wind velocity but not less than 10 seconds.
- G. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to **13 feet 6 inches**, and to 1/240 of clear span plus **1/4 inch**, for spans greater than **13 feet 6 inches** or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or **1/8 inch**, whichever is smaller.
- H. Thermal Movements: Provide glazed aluminum curtain-wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): **120 deg F**, ambient; **180 deg F**, material surfaces.
- I. Air Infiltration: Provide glazed aluminum curtain-wall systems with maximum air leakage of **0.06 cfm/sq. ft.** of fixed wall area when tested according to ASTM E 283 at a minimum static- air-pressure differential of **6.24 lbf/sq. ft.**
- J. Water Penetration Under Static Pressure: Provide aluminum glazed curtain-wall systems that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft..
- K. Water Penetration Under Dynamic Pressure: Provide glazed aluminum curtain-wall systems that do not evidence water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive design wind load, but not less than **10 lbf/sq. ft.**
1. Maximum Water Leakage: No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.
- L. Condensation Resistance: Provide glazed aluminum curtain-wall systems with condensation- resistance factor (CRF) of not less than 70 when tested according to AAMA 1503.
- M. Average Thermal Conductance: Provide glazed aluminum curtain-wall systems with average U-factor of not more than **0.48 Btu/sq. ft. x h x deg F** when tested according to

AAMA 1503.

1.4 SUBMITTALS

- A. General: Submit in accordance with Section 01330.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated. Include manufacturer's installation instructions for system specified.
- C. Shop Drawings: Show fabrication and installation of glazed aluminum curtain wall system including plans, elevations, sections, details of components, rough openings, flashing, and attachments to other units of Work.
- D. Samples for Sealants: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of performing Work of this Section and who is acceptable to manufacturer.
- B. Source Limitations: Obtain glazed aluminum curtain wall system from one source and by a single manufacturer. Glazed aluminum curtain wall systems specified in this Section and aluminum entrances and storefront systems specified in Division 8 Section "Aluminum-Framed Entrances and Storefronts" shall be from same manufacturer.
- C. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain-wall systems by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate submittal and fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating glazed aluminum curtain-wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Kawneer Company, Inc.; 1600 Wall System.
 - 2. Vistawall Architectural Products; 2600 Thermal Curtain Wall System.

2.2 FRAMING SYSTEMS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use

and finish indicated.

1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B429.
 4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 611.
 3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.
- C. System Components:
1. System Depth: Extruded aluminum, thermally isolated, 6 inch by 2-1/2 inch.
 2. Flashing: Minimum 0.063-inch thick aluminum brake material, unless otherwise noted; factory formed to detail; finish to match curtain wall.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. At pressure caps, use ASTM A 193 stainless steel screws.
 3. Reinforce members as required to receive fastener threads.
 4. Use exposed fasteners with countersunk Phillips screw heads finished to match framing members, unless otherwise indicated. Exposed fasteners shall be stainless steel.
 5. Finish exposed portions to match framing system.
 6. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.
- F. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- G. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- H. Framing Gaskets: As recommended by manufacturer for joint type.
- I. Framing Sealants: As specified in Division 7 Section "Joint Sealants."

2.3 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glazing."

- B. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, glazing gaskets, complying with ASTM C 864, extruded of a silicone compatible EPDM rubber that provides for silicone adhesion. Provide setting blocks, and shims or spacers; in hardness recommended by manufacturer.

2.4 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.5 FABRICATION

- A. General: Fabricate glazed aluminum curtain wall system according to Shop Drawings. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- B. Fabricate components that, when assembled, have the following characteristics:
 1. Sharp profiles, straight and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.
 6. Provisions for reglazing from exterior.
- C. Welding: Weld components to comply with referenced standard and Shop Drawings, unless otherwise indicated. Weld before finishing components. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- D. Prepare components to receive concealed fasteners, anchors, and connection devices.
- E. Fabricate components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within system to exterior.
- F. Glazing Pockets: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- G. Metal Protection: Where aluminum contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum contacts concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural ClassII, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected or accommodations acceptable to Architect have been made.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing glazed aluminum curtain wall system and the following:
 - 1. Do not install damaged components.
 - 2. Fit joints to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 5. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - 6. Seal joints watertight, unless otherwise indicated.
 - 7. Provide means to drain water to the exterior to produce a permanently weatherproof system.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in a full sealant bed as specified in Division 7 Section "Joint Sealants" and to provide weathertight construction, unless otherwise indicated. Install sills in one piece, full width of opening except where opening exceeds available manufactured lengths. Provide sealed metal end dams at ends of sills. Sills shall turn up on backside to form pan, directing water to the exterior.
- D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- E. Install components plumb and true in alignment with established lines and grades.

- F. Anchorage: After system components are positioned, fix connections to building structure as indicated on Shop Drawings.
1. Provide separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 2. Arrange fasteners and attachments to conceal from view.
- G. Welding: Weld components to comply with referenced standard and Shop Drawings, unless otherwise indicated. Weld in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- H. Glazing: Install in accordance with Shop Drawings and complying with requirements as specified Division 8 Section "Glazing."
- I. Install weatherseal sealants in accordance with Shop Drawings and complying with requirements as specified in Division 7 Section "Joint Sealants," unless otherwise indicated.
1. Install backer rod and sealant around exterior of opening, back from cover plate, sealing perimeter weather tight. Install backer rod and sealant around rear of curtain wall frame to inside of rough opening between frame and air/vapor barrier. The intention is to provide a double seal to reduce the chance of water infiltration due to interior negative pressure.
 2. Color of sealant shall match aluminum finish.
- J. Erection Tolerances: Install glazed aluminum curtain-wall systems to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or greater, limit offset from true alignment to 1/4 inch.
 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.3 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure glazed aluminum curtain wall system is without damage or deterioration at time of Substantial Completion. Protect finish, seals, and other components from damage.

END OF SECTION 089110

SECTION 092300- GYPSUM BOARD ASSEMBLIES

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. Interior gypsum wallboard.
 - 2. Acoustical insulation in framed assemblies.
 - 3. Firestopping.
 - 4. Smoke sealing.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Framing" for framing, furring and concealed blocking.
 - 2. Division 7 Section "Building Insulation" for exterior thermal insulation and vapor retarders.
 - 3. Division 7 Section "Through-Penetration Firestop Systems" for systems not part of this Section.

1.03 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- D. Firestopping: For each joint condition where fire-rated walls and partitions interface other walls, floors, structural members or other building structure, provide UL firestop system description and drawing. Show each kind of construction condition and relationships to adjoining construction. Indicate which firestop materials will be used where and thickness for different hourly ratings. Include UL firestop design designation that evidences compliance with requirements for each condition.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory," GA-600, "Fire Resistance Design Manual" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Source Limitations for Panel Products: Obtain each type of gypsum board and other panel products from a single source from a single manufacturer.
- C. Source Limitations for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours before application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Gypsum Board and Related Products:
 - a. CertainTeed - Pro Roc Brand Gypsum Board products.
 - b. Manufacturing location: Toronto, ON, Canada L5JK4

2.02 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
 - 1. Type X:
 - a. Thickness: 5/8 inch, 1/2 inch.
 - b. Long Edges: Tapered.
- C. Water-Resistant Gypsum Board (MR): ASTM C 630/C 630M.
 - 1. Thickness: 5/8 inch, toilet room
 - 2. Long Edges: Tapered
- D. USG Durock Cement Board
 - 1. Thickness: 1/2 inch at thin brick feature wall
 - 2. 4 ft x 8 ft x 1/2 inch sheet sizes.
- E. Long Edges: Tapered.
- F. 5/8 inch thick cement board located at feature tile walls.

2.03 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047, galvanized steel.
 - 1. Shapes:
 - a. Cornerbead: 1-1/4 inch x 1-1/4 inch external corner with 1/8-inch nose bead. Use at outside corners, unless otherwise indicated.
 - b. LC-Bead (Casing): J-shaped casing with 1/16-inch nose bead ground, not less than 30 gage; exposed long flange receives joint compound; use at exposed panel edges.
 - c. Expansion (Control) Joint: One-piece control joint formed with V-shaped slot and removable strip covering slot opening.

2.04 Accessories for Curved Edges: Corner bead formed of metal, plastic, or metal combined with plastic, with either notched or flexible flanges that are bendable to curvature radius.

2.05 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper reinforcing tape. Fiberglass tape not permitted.
- C. Setting-Type Joint Compound: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
 - 1. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.

2. For topping compound, use sandable formulation.
- D. Drying-Type Joint Compound: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.
1. Ready-Mixed Formulation: Factory-mixed product.
- E. Type of Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Pre-filling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.

2.06 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
 2. Acoustical Sealant for Concealed Joints:
 - a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
 - b. Pecora Corp.; BA-98.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.
- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.07 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Fastening gypsum board to wood members: Type W bugle head.
- C. Sound Attenuation Insulation: ASTM C 665, Type I (fiberglass blankets without membrane facing) used as acoustical insulation.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Certainteed.
 - b. Owens Corning.
 - c. Johns Manville.
- D. Thermal Insulation: Specified in Division 7 Section "Building Insulation."
- E. Insulation Support Anchors: Insul-Fast 25 gauge galvanized continuous metal support strip with pre-punched tabs at 8 inches on center.
- F. Polyethylene Vapor Retarder: Specified in Division 7 Section "Building Insulation."
- G. Firestopping: See Division 7 Section "Through-Penetration Firestop Systems." Provide firestopping where fire rated gypsum board assemblies butt dissimilar materials; including masonry, steel deck, joists, beams and structural members as part of the gypsum board assembly work. Penetrations through fire-resistance-rated walls and partitions by Division 15 and 16 work, including both empty openings and openings containing cables, pipes, ducts and conduits are specified as part of the Division 15 and 16 work.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Additionally, inspect the walls for dents and imperfections, with the Installer and painter present, prior to painting. Inspect walls again after primer and first coat of paint applied, with Installer and painter present. Installer shall touch-up as follows:
 - a. Touch-up visible gypsum board imperfections before priming of walls.
 - b. Touch-up imperfections found in field of boards and joints made visible from painting after first finish coat applied.

3.02 INSTALLATION OF ACOUSTICAL INSULATION

- A. Install acoustical insulation at locations indicated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.
- B. Install a single layer of insulation of required thickness to fill the full depth of cavity, unless otherwise shown. Where cavity requires insulation that is thicker than standard size, install next larger size and compress into cavity.
- C. Hold batt insulation in place with insulation support anchors located at 5 feet on center full height of wall, starting at the top of each stud space.

- D. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces. Fill box headers, and voids while framing is being erected that will be inaccessible for installation later. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

3.03 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216, except as specified otherwise.
- B. Install acoustical insulation, where indicated, before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch** of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Do not attach gypsum panels across the flat grain of wide-dimension lumber. Float gypsum panels over these members.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels.
 - 1. Where control joints are not shown, provide control joints at a maximum spacing of 30 feet; review proposed locations with Architect.
- J. Cover both faces of stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft.** in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by members; allow **1/4- to 3/8-inch** wide joints to install sealant.
- K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch** wide spaces at these locations, and trim edges with casing bead

edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- L. Floating Construction: Where feasible, including where recommended in writing by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.
- M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of **12 inches** o.c. for vertical applications.
- N. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.
- O. Remove screws that do not hit studs, supports, or blocking.

3.04 PANEL APPLICATION METHODS

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On underside of trusses, install ceiling gypsum panels before installing wall studs to provide continuous surface over partitions for both rated and non-rated conditions.
 - 3. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
- B. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
- C. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- D. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.05 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Install corner bead at external corners.

- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated. Screw attach trim in addition to crimping.
 - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 - 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
 - 3. Install U-bead where indicated.
- D. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.06 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of corner bead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Pre-fill open joints, rounded or beveled edges, and damaged surface areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.
- E. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 1: At ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
- F. Where Level 1 gypsum board finish is indicated, embed tape in joint compound. Surface shall be free of excess joint compound.
- G. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.
 - 1. At tapered edge joints, draw the compound down to a level plane, leaving a monolithic surface that is flush with the paper face. Finish coat shall be feathered a minimum of 8 inches beyond both sides of the center of joint tape.
 - 2. At end to end butt joints, draw the compound down to minimize the hump created by the joint tape application. Finish coat shall be feathered a minimum of 16 inches beyond both sides of the center of the joint tape.
 - 3. The end product shall be a surface that appears level without telegraphing joint locations as high spots when viewed down the wall after painting.

4. Finish board to within 1/4 inch of the floor, providing full support for resilient wall base without telegraphing joint.

3.07 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.

3.08 CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 092300

SECTION 093100 - TILE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Porcelain tile.
 - 2. Decorative Tiles
 - 3. Underlayment.
 - 4. Metal Edge Strips.

1.2 DEFINITIONS

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
- B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).
- C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.3 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the values indicated as determined by testing identical products per ASTM C 1028.

1.4 SUBMITTALS

- A. Product Data: For each type of tile, mortar, grout, and other products specified.
- B. Shop Drawings: For the following:
 - 1. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Tile Samples for Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.
- D. Grout Samples for Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.
- E. Samples of Accessories: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.
 - 1. Metal edge strips in 6-inch (150-mm) lengths.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Store tile and Cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers and Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the following paragraphs of Part 2.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
1. As selected by Architect from manufacturer's full range.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.
1. Where tile is indicated for installation in swimming pools, on exteriors, or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for these kinds of installations and has a record of successful in-service performance.

2.3 TILE PRODUCTS

- A. Porcelain Tile: T1 Provide flat tile complying with the following requirements:
1. Composition: Porcelain.
 2. Facial Dimensions: 24" by 24".
 3. Thickness: 3/8".
 4. Face: Plain with cushion edges.
 5. Static Coefficient of Friction: Level Surfaces, minimum .42.
 6. Tile Type/Products: Available products include the following:
 - a. Daltile, Colorbody Porcelain, Haut monde.
 - b. Colors: As indicated in the Interior Finish Legend.
 7. Provide tile base & trim – refer to finish legend.
- B. Decorative Wall Tile: TB1, T2 Provide tile complying with the following requirements:
1. Composition: Mosaic field tile
 2. Facial dimensions: 12" x 24".
 3. Tile products: Available products include the following:
 - a. Stone Peak, Quartzite.
 - b. Finishes: As indicated in the Interior Finish Legend.
 - c. Colors: As indicated in the Interior Finish Legend.
 4. Trim: Install Schluter rondel edge protection at wall tile.
- C. Decorative Tile T3: Provide tile complying with the following requirements:
1. Composition: Thin brick veneer
 2. Facial Dimensions: 12" x 24".

3. Tile Products:
 - a. Boral Bricks
 - b. Finishes: as indicated on finish legend
 - c. Colors: as indicated on finish legend.

2.4 SETTING MATERIALS

- A. Proma Prosuperlite Mortar: ANSI A118.4, composed as follows:
 1. Prepackaged dry-mortar mix.
 - a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

2.5 GROUTING MATERIALS

- A. Polymer-Modified Tile Grout: ANSI A118.7, color as indicated.
 1. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.
 - a. Unsanded grout mixture for joints **1/8-nch (3.2 mm)** and narrower.

2.6 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard sanded acrylic caulking containing a mildew-cide or antimicrobial protection.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. Products: Available products include the following:
 1. Keracaulk™ S by Mapei
 2. CeramaSeal by Bostik Findley

2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Aluminum strips, **1/8-nch (3.2 mm)** wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.
 1. Provide Schiene by Schluter or approved substitute.
- C. Crack Suppression for Thin Set Tile:
 1. Sheet or trowelable membrane designed to bridge small cracks for tile setting applications. Provide one of the following products:
 - a. Laticrete 9235 Waterproof & Anti-Fracture Membrane
 - b. Nobleseal CIS

- c. Hydroment Ultra-Set
- d. Mapei PRP M19

D. Metal edge trim: Schluter rondel to be used at wall tile applications

2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- B. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill minor cracks.
- C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match

approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

- D. Cracks and Control Joints for Thin-Set Tile:
 - 1. Install crack suppression materials a minimum of 12-inches wide over cracks and control joints. Install in accordance with manufacturer's instructions.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- F. Grout tile to comply with the requirements of the following tile installation standards:
 - 1. For ceramic tile grouts (sand-Portland cement, commercial Portland cement, and latex-Portland cement grouts), comply with ANSI A108.10.
 - 2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.
 - 3. For chemical-resistant furan grouts, comply with ANSI A108.8.
- G. Joint Sealants: Install sealant in floor tile joint directly above control joints and crack suppression material. Install sealant in tile joint at perimeter edges of floor tile and tile base or dissimilar base materials.

3.4 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.

- B. Joint Widths: Install tile on floors with the following joint widths:
 - 1. Porcelain Tile: **1/16-nch.**
- C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.5 WALL TRIM INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joint widths:
 - 1. Wall Trim: **1/16-nch.**

3.6 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove epoxy and latex-Portland cement grout residue from tile as soon as possible.
 - 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure tile is without damage or deterioration at the time of Substantial Completion.
 - 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with carpet pad or other heavy covering during construction period to prevent staining, damage, and wear.
 - 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, rinse neutral cleaner from tile surfaces.

3.7 TILE FLOOR INSTALLATION SCHEDULE

- A. Tile Floor Installation: Where interior floor installations of this designation are indicated, comply with the following:
 - 1. Tile Type: Porcelain tile.
 - 2. Installation Method: TCA F113 (thin-set mortar bonded to concrete subfloor).
 - 3. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:
 - a. Latex-Portland cement mortar.

- b. Unsanded polymer-modified tile grout.
- B. Tile Floor Installation: Where interior floor installations of this designation are indicated, comply with the following:
- 1. Tile Type: Porcelain tile.
 - 2. Installation Method: TCA F150/160 (thin-set mortar on exterior-glue plywood).
 - 3. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:
 - a. EGP latex-Portland cement mortar.
 - b. Unsanded polymer-modified tile grout.

3.8 TILE WALL INSTALLATION SCHEDULE

- A. Wall Trim Installations: Where interior wall installations of this designation are indicated, comply with the following:
- 1. Tile Type: Porcelain and mosaic trim.
 - 2. Installation Method: TCA W243 (thin-set mortar bonded to gypsum board on metal studs).
 - 3. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:
 - a. Proma pro superlite mortar.
 - b. Unsanded polymer-modified tile grout.

END OF SECTION 093100

SECTION 095110 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems.

1.2 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. 6-inch- (150-mm-) square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch- (300-mm-) long samples of exposed suspension system members, including moldings, for each color and system type required.
- C. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products. Insert specific model code organization below or revise if report must be from another source.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
 - 1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.

2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
3. Fire-resistance-rated assemblies, which are indicated by design designations from UL's "Fire Resistance Directory," from ITS/Warnock Hersey's "Directory of Listed Products," or from the listings of another testing and inspecting agency, are identical in materials and construction to those tested per ASTM E 119.
4. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of acoustical panels 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.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.
 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the following paragraphs of Part 2.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Antimicrobial Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial solution consisting of a synergistic blend of substituted ammonium salts of alkylated phosphoric acids admixed with free alkylated phosphoric acid that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria.
- D. Acoustical Panels Type ACT-1:
1. Surface Texture: Fine.
 2. Composition: Mineral Fiber.
 3. Color: White
 4. Size: 24-inches x 24-inches x 5/8-inch.
 5. Edge Profile: Square lay-in with Prelude XL 15/16-inch Exposed Tee.
 6. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 1.00.
 7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton, N/A.
 8. Flame Spread: ASTM E 1264; Class A (UL).
 9. Light Reflectance (LR): ASTM E 1477; White Panel; Light Reflectance: 0.90.
 10. Dimensional Stability: HumiGuard Plus - temperatures up to 120 degrees F and high humidity excluding only exterior use.
 11. Mold/Mildew Inhibitor: The front and back of the product have been treated with BioBlock, a paint that contains a special biocide that inhibits or retards the growth of mold or mildew, ASTM D 3273.

12. Acceptable Product: Wide faced, capped web steel by Armstrong World Industries, Armstrong Optima Open Plan #3159.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, UL certified load compliance, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Suspension System for Acoustical Panel Ceilings (ACT-1 & ACT-2): Where this designation is indicated, provide acoustical panel ceiling suspension system complying with the following:
 1. Products: Provide one of the following:
 - a. Prelude 15/16" Exposed Tee System; Armstrong World Industries, Inc.
 - b. S11 System; Celotex Corporation.
 - c. 1200 System; Chicago Metallic Corporation.
 - d. DX 24 System; USG Interiors, Inc.
 2. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G01 coating designation, with prefinished 15/16-inch- wide metal caps on flanges; other characteristics as follows:
 - a. Structural Classification: Intermediate-duty system.
 - b. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
 - c. Face Design: Flush face.
 - d. Cap Material: Steel sheet.
 - e. Cap Finish: Painted white.
- C. Suspension System for Acoustical Panel Ceilings (ACT-3): Where this designation is indicated, provide acoustical Cloud System complying with the following:
 1. Products: Provide one of the following:
 - a. Armstrong: Individual attachment suspended system.
- D. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide as indicated above.
- E. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
 1. Post installed Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- F. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- G. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- H. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- I. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.
- J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
1. Available Product: UHDC by Armstrong or L15 by USG.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
- B. Suspend ceiling hangers and aircraft cable from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means. Do not splay aircraft cable.
 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing; counter splaying, or other equally effective means. Do not splay aircraft cable.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.
 11. Space aircraft cable suspension system as recommended by manufacturer.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
- D. Install edge moldings and trim of type indicated or required at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Screw attach moldings to substrate at intervals not more than **16-inches** o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of **1/8-inch in 12-feet**. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim except where required for vertical framing.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fitted accurately.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down clips in areas within **10-feet** of exterior doors or vestibule doors; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.

3.4 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs acoustical panel ceilings, conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of acoustical panels until deficiencies have been corrected.
1. Complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of through-penetration firestop systems.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096800 - CARPET

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Carpet.
- B. Related Sections include the following:
 - 1. Division 9 Section "Resilient Flooring" for resilient wall base and accessories installed with carpet.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet: 12-inch- (300-mm-) square Sample.
- C. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.
- D. Maintenance Data: For carpet to include in maintenance manuals specified in Division 1. Include the following:
 - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet.
- E. CRI Labels: Provide data or certificates showing the carpet and adhesives meet the requirements of CRI Indoor Air Quality Carpet and Adhesive Testing Programs.
- F. Test Results: Provide results of specified alkalinity and adhesion tests, calcium chloride moisture tests, and relative humidity test for each resilient flooring type specified. Include manufacturer's written moisture requirements for each resilient flooring type specified.
- G. No substitutions.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered. Refer to Division 1 Section "Product Requirements."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Carpet Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET

- A. C1
 - 1. Manufacturer: J & J/Invision
 - 2. Product/Style: Meadow 7097 Modular
 - 3. Color: Indicated on Finish Legend

4. Finish: Factory
5. Surface texture: textured Patterned Loop
6. Fiber Type: Encore BCF
7. Dye method: Solution/yarn dyed.
8. Machine gauge: 1/12
9. Backing: Nexus modular
10. Size: 24" x 24"
11. Warranty: Lifetime Commercial Limited
12. Performance characteristics:
 - a. Pill test: CAN/CGSB-4. 129-93/DOC FF1-70.
 - b. Flooring Radiant Panel:
 - c. NBS Smoke Chamber: NFPA-258 (ASTM E662) Flaming Mode – 450 or less
 - d. Static Propensity: 3.5 KV or less
13. Environmental characteristics: CRI Green Label, CRI No. 9716.

B. C2

1. Manufacturer: Angela Adams
2. Product/Style: Harbor
3. Color: Custom
4. Finish: factory
5. Construction/Material: Hand-tufted 100% New Zealand Wool
6. Dye method: Solution dyed
7. Size: 9' x 10" freeform pattern

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the following:
 1. Carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the following:
 1. Carpet manufacturer.
- C. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
 1. Use a solvent based seam sealer with double stick installations. Do not use hot-melt tape.
- D. Primer: Provide products recommended by carpet manufacturer. Provide primer that is compatible with adhesive.
- E. Transition Strips: Refer to Division 9

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
 - 2. Verify that adhesion and dryness characteristics have been determined as required in Division 7 Section "Vapor Retarders, Vapor Barriers, and Air Barriers" and meet flooring manufacturer's recommendations.
 - a. If alkaline content is greater than 9, or is such that it may cause future delaminating of the carpet, per manufacturer's printed instructions, coordinate with General Contractor for the application of carpet manufacturer's recommended primer, adhesives and seam sealers.
 - 3. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.
 - 4. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.
- B. Cut carpet bails open to full length of rolls to allow the carpet to ventilate a minimum of 72 hours prior to installation.
- C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill minor cracks, holes, and depressions in substrates.
- D. Coordinate with General Contractor for the removal of coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Direct-Glue-Down Installation: Install carpet in strict accordance with the Carpet and Rug Institute's IAQ (indoor air quality) Installation guidelines as well as with the U.S. Environmental Protection Agency's guidelines. Install carpet in accordance with the recommendations in CRI 104 and the carpet manufacturer's specifications.

- B. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- D. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section 15, "Protection of Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

3.5 BUILDING VENTILATION

- A. Operate the building ventilation systems at maximum outdoor air flow before, during and 72 hours after the new carpet installation. Open windows and/or doors when possible during the carpet installation.

END OF SECTION 096800

SECTION 099000 - PAINTING

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. Exposed exterior items and surfaces with low VOC coatings.
 2. Exposed interior items and surfaces with low VOC coatings.
 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Related Sections include the following:
1. Division 2 Sections for traffic-marking paint and fencing.
 2. Division 5 Section "Structural Steel" for shop priming structural steel and for color galvanizing finish on exterior architectural steel columns and connections.
 3. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
 4. Division 6 Section "Finish Carpentry" for surface preparation of exterior carpentry and interior standing and running trim and finish carpentry.
 5. Division 6 Section "Architectural Woodwork" for shop finishing of architectural casework.
 6. Division 8 Section "Steel Frames" for factory priming steel doors and frames.
 7. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
 8. Review all sections for shop primed items requiring field painting.

1.03 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
 4. Semi gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 5. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 01330.

- B. Product Data: For each paint system indicated, including block fillers and primers.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- C. Schedule: Provide schedule of all surfaces to be coated, with prime and finish coat material listed, and manufacturer's recommended wet film thickness.
- D. Samples: For each type of exposed finish required, submit color chips, 3- by 5-inches, matching colors indicated on Finish Schedule.
 - 1. Obtain written approval of color match to Architect's before ordering paint.
- E. Manufacturer Certificates: Signed by manufacturers certifying that products with limit VOC amounts specified comply with requirements.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced Applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly.
 - 2. Remove oily rags and waste daily.
 - 3. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.07 PROJECT CONDITIONS

- A. Apply paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
 - 2. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.
- B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Benjamin Moore & Company (Moore).
 - 2. ICI Dulux Paints (ICI).
 - 3. Sherwin-Williams Co. (S-W).

2.02 COATINGS MATERIALS, GENERAL

- A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best quality coating material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers listed in the specification schedule. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
 - 2. Where schedule says no substitution, use proprietary product only. Do not propose substitutions, as the products from the other manufacturers have been considered, and are not acceptable.
- C. Colors: Provide color selections made by the Architect, refer to interior finish legend.
- D. VOC Compliance: Provide the manufacturer's formulation for the products specified below that are VOC compliant with the State of Maine Department of Environmental Protection Regulation, "Chapter 151:
 - 1. Architectural and Industrial Maintenance (AIM) Coatings"

- a. Standard South Coast Air Quality Management District, Rule #1168.
 - b. Green Seal Standard GS-36.
 - c. Green Seal Standard GS-11.
 - d. Green Seal Standard GC-03.
2. The following chemical restrictions expressed in grams per liter:
- a. Flat Paints and Coatings: VOC content of not more than 100 g/L.
 - b. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
 - c. Non-Flat Paints and Coatings - High Gloss: VOC content of not more than 250 g/L.
 - d. Anticorrosive (Rust Preventative) Coatings: VOC content of not more than 400 g/L.
5. Clear Wood Coatings:
- a. Clear Brushing Lacquers: VOC content of not more than 680 g/L.
 - b. Lacquers (Including Lacquer Sanding Sealers): VOC content of not more than 550 g/L.
 - c. Sanding Sealers (Other than Lacquer Sanding Sealers): VOC content of not more than 350 g/L.
 - d. Varnishes: VOC content of not more than 350 g/L.
 - e. Stains: VOC content of not more than 250 g/L.
6. Fire Resistive Coatings: VOC content of not more than 650 g/L.
7. Fire Retardant Coatings:
- a. Clear: VOC content of not more than 650 g/L.
 - b. Opaque: VOC content of not more than 350 g/L.
8. Floor Coatings: VOC content of not more than 250 g/L.
9. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
10. Quick-Dry Enamels: VOC content of not more than 250 g/L.
11. Quick-Dry Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
12. Specialty Primers, Sealers, and Undercoaters: VOC content of not more than 350 g/L.
13. Stains: VOC content of not more than 250 g/L.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator and drywall subcontractor present, under which painting will be performed for compliance with paint application requirements.
 1. If unacceptable conditions are encountered, prepare written report, endorsed by Applicator, listing conditions detrimental to performance of work.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Application of coating indicates Applicator's acceptance of surfaces and conditions within a particular area.
 4. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure

compatibility of the total system for various substrates. On request, furnish information on characteristics of specified finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturers written instructions for each particular substrate condition and as specified.
 1. Provide barrier coats over incompatible primers or remove and re-prime.
 2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood.
 - c. If transparent finish is required, back prime with spar varnish.
 3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 4. Galvanized Surfaces: Uniformly abrade galvanized surfaces with a palm sander and 60 grit aluminum oxide so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
 - a. Clean field welds with non petroleum-based solvents so surface is free of oil and surface contaminants.
 5. Nonferrous Metals: Clean surfaces according to manufacturer's written instructions for the type of service, metal substrate, and application required.
 6. PVC: Clean surfaces prior to coating per manufacturer's requirements.

- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.03 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Use applicators and techniques best suited for the coating being applied.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 4. Provide finish coats that are compatible with primers used.
 5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 7. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 9. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 10. Sand lightly between each succeeding enamel and varnish coat.
 11. Finish cut edges of Cementitious siding to match finish color (2 coats).
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film are of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not

cause undercoat to lift or lose adhesion.

- C. Paint all exposed surfaces, except where paint schedules indicate that a surface or material is not to be painted or is to remain natural. If paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color-coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment at all locations except mechanical and electrical rooms.
- D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- E. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions. Walls shall have roller finish.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- G. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces (outside mechanical and electrical rooms).
- H. Mechanical items to be painted include, but are not limited to, the following:
 - 1. Piping, pipe hangers and supports.
 - 2. Heat exchangers.
 - 3. Tanks.
 - 4. Ductwork, including interior of ductwork visible through air devices.
 - 5. Insulation.
 - 6. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - 7. Motors and mechanical equipment.
 - 8. Accessory items.
- I. Electrical items to be painted include, but are not limited to, the following:
 - 1. Conduit and fittings.
 - 2. Switchgear.
 - 3. Panelboards.

- J. Exterior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following:
 - 1. Metal Fabrications. See Section 05500.
 - 2. Miscellaneous metal items.
 - 3. Bollards.

- K. Interior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following:
 - 1. Handrails and guardrails.
 - 2. Steel doors and frames.
 - 3. Countertop supports.
 - 4. Metal fabrications. See Section 05500.
 - 5. Miscellaneous metal items.

- L. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

- M. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- N. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats, unless otherwise noted.

- O. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

- P. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.05 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective

wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINT SCHEDULE

- A. Ferrous and Zinc-Coated Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
1. Semi gloss, Acrylic-Enamel Finish: 2 finish coats over a rust-inhibitive primer.
 - a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) Moore: Moore's IMC M04 Acrylic Metal Primer; 2.0 mils DFT.
 - 2) ICI: 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
 - 3) S-W: Galvite HS, B50WZ30; 3.5 DFT.
 - b. First and Second Coats: Semi gloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) Moore: Moorecraft Super Spec Latex House & Trim Paint No. 170; **2.2 mils DFT.**
 - 2) ICI: 2416-XXXX, Ultra-Hide Durus Exterior Acrylic Semi-Gloss Finish; **3.0 DFT.**
 - 3) S-W: Duration Exterior Gloss Latex Coating; **5.6 mils DFT.**

3.07 INTERIOR PAINT SCHEDULE LOW ODOR, LOW VOC COATINGS

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
1. Flat Acrylic Finish (GWB Ceilings): 2 finish coats over a primer.
 - a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: ProGreen 200 Latex Wall Primer B28W600 Series; **1.5 mils DFT.**
 - b. First and Second Coats: Flat, acrylic-latex-based, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: ProGreen 200 Interior Latex Flat Wall Paint B30W600 Series; **1.8 mils DFT.**
 2. Low-Sheen, Latex-based (Gypsum Board Walls): 2 finish coats over a primer.
 - a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: ProGreen 200 Latex Wall Primer B28W600 Series; **1.5 mils DFT.**
 - b. First and Second Coats: Low-sheen (eggshell), latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.

- 1) S-W: ProGreen 200 Interior Latex Egg-Shell Enamel B201600 Series; **3.2 mils DFT.**
- B. Woodwork, Opaque Finish: Provide the following paint finish systems over new, interior wood surfaces:
1. Low-Luster, Acrylic-Enamel Finish (Light Coves): 2 finish coats over a primer.
 - a. Primer: Stain-blocking, alkyd- or acrylic-latex-based, interior wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: PrepRite Wall and Wood Primer B49WZ2; **2.2 mils DFT.**
 - b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: ProGreen 200 Interior Latex Egg-Shell Enamel B201600 Series; **3.2 mils DFT.**
 2. Semi-gloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
 - a. Primer: Stain-blocking, alkyd- or acrylic-latex-based, interior wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: PrepRite Wall and Wood Primer B49WZ2; **1.9 mils DFT.**
 - b. First and Second Coats: Semi gloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: ProGreen 200 Interior Latex Semi-Gloss Enamel B31-600 Series; **3.0 mils DFT.**
- C. Natural-finish Woodwork: Provide the following natural finishes over interior woodwork:
1. Waterborne, Satin-Varnish Finish: 3 finish coats of a Waterborne, clear-satin varnish over interior wood stain.
 - a. Stain Coat: Interior wood stain applied at spreading rate recommended by the manufacturer. Low VOC compliant.
 - 1) Moore: Benwood Penetrating Stain.
 - 2) ICI: 1700-XXXX, WoodPride Interior Solventborne Wood Finishing Stain.
 - 3) S-W: Wood Classics Interior Oil Stain A-48 Series.
 - b. First, Second and Third Finish Coats: Waterborne, varnish finish applied at spreading rate recommended by manufacturer.
 - 1) Moore: Stays Clear Acrylic Polyurethane #423, Satin.
 - 2) ICI: 1802-0000, Woodpride Interior Aquacrylic Satin Varnish.
 - 3) S-W: MinMax Polycrylic.
- E. Ferrous and Zinc-Coated Metal: Provide the following finish systems over ferrous metal:
1. Semi gloss, Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Quick-drying, corrosion-resistant, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a dry film thickness of not less than indicated for product.

- 1) S-W: Galvite HS Paint B50WZ30; 3.5 mils DFT.
 - b. First and Second Coats: Semi gloss, corrosion-resistant, acrylic interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) S-W: ProMar 200 Interior Latex Semi-Gloss B31-2200 Series; 3.0 mils DFT.
- F. Telecommunication, Data, and Electrical Backboards: Provide the following finish over plywood:
 1. Flat Intumescent Finish: Two finish coats over a primer.
 - a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) Moore: Pristine EcoSpec Interior Latex Primer Sealer 231; 0.8 mils DFT.
 - b. First and Second Coats: Intumescent-type, fire-retardant paint applied at spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than 4 mils; white color for telecommunication and data and black for electrical.
 - 1) Moore: M59 220 Latex Fire-Retardant Coating.
- G. Wood Trim, Millwork, Opaque Finish: Provide the following fire retardant protection and paint finish systems over new, interior wood surfaces:
 1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over fire retardant barrier coating to provide Class A fire surface burning classification.
 - a. Fire Retardant Coating: Spray applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 7.5 mils.
 - i. Flame Seal Products Inc. (713)668-4291: FX-100 Fire Retardant Barrier Coating. BSIWOO450-Multipurpose Zero VOC Interior/Exterior latex primer.
 - b. First and Second Coats: Low-Luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - i. S-W:04120515 – Flame control No. 20-20 Flat Latex Paint.
- H. Fire-Rating Identification: Identify all 1- and 2-hour fire-rated partitions by stenciling rating on each side of rated walls above ceiling line with 4 inch high letters in red or orange semigloss paint; each rated wall shall be identified at least once and at a spacing not greater than 12 feet o.c.
 1. First Coat: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - a. S-W: ProGreen 200 Low VOC Interior Latex Semi-Gloss B31-600 Series; 1.6 mils DFT.

END OF SECTION 099000

SECTION 104310 - SIGNS

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 interior panel signs.
- B. Client logo signs
- C. Related Sections include the following:
 - 1. Division 2 Sections for site signage.

1.03 SUBMITTALS

- A. General: Submit in accordance with Section 01330.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
- C. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
 - 1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and Braille layout.
- D. Samples for Initial Selection: For each type of sign material indicated that involves color selection.
- E. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

1.05 COMPLIANCE

- A. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction, conditions noted and specified requirements.
 - 1. Sign Finish and Contrast: The color selected for the character and

symbols shall be in marked contrast to the sign background. Characters and background shall be matte or other non-glare finish.

2. Tactile and Braille: Characters shall be raised **1/32-inch** and be accompanied by Grade II Braille.
3. Typestyle - Characters must be uppercase and san serif or simple serif style. Directional and informational signs are allowed to include lower case letters. Characters must have width-to-height ratio of between 3:5 to 1:1. Characters must have a stroke to height ratio of 1:5 to 1:10.
4. Character Height -Tactile characters height must be between 5/8" and 2", all caps. Characters on projected or overhead signs must be a minimum of 3" high. Characters on directional signs and informational signs must be sized appropriate or the viewing distance.
5. Pictograms: Shall be accompanied by the equivalent written description placed directly below pictogram and be in a background area of at least 6- x 6-inches.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.07 COORDINATION

- A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 1. Basis-of-Design Product: The design for each sign is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 SIGNS

- A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
 1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus **1/16 inch** measured diagonally.
- B. Basis-of-Design Product: Welch Architectural Signage, 7 Lincoln Ave, Scarborough, ME 04074. Phone (800) 635-3506 - Fax (800) 225-6859; contact: Jeff Pappalardo.

2.03 SIGN TYPES COMMON AREAS

- A. Interior Panel Signs:
1. Substrate: Fabricate signs from 1/8 inch thick matte clear acrylic with 1/4" beveled backer plate. Backer plate from 1/8-inch thick Matte clear acrylic. Edges mechanically and smoothly finished to eliminate cut marks. Background color to be subsurface design of sign.
 2. Background Color: Custom color to be selected by Architect.
 3. Edges: Straight.
 4. Corners: Rounded.
 5. Size: As indicated.
 6. Copy: Helvetica or as shown on drawings.
 7. Copy Color: To be selected by Architect from manufacturer's standards.
 8. Letterform: Apply 1/32-inch computer precision cut tactile copy. All uppercase, normal spacing, 5/8-inch minimum letter height. Tactile letters will be applied in a manner that avoids scoring of the sign's surface at base of tactile letters.
 9. Braille: Use raster process to create all Braille cells. Drill holes in each dot location and fit clear raster balls into each hole.

2.04 FINISHES, GENERAL

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.
- B. Client Logo Signs – Aluminum. Provide sign(s) as detailed on drawings and having the following characteristics:
1. Flat cut dimensional 3/8" thick matte black symbols and individually prepared aluminum sections for logo.
 2. Size: As indicated.
 3. Style and Size: As selected by Architect.

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 work.
- B. Verify that items provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Locate signs and accessories where indicated, using mounting methods in compliance with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within **3-inches** of sign without encountering protruding objects or standing within swing of door.

3.03 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

3.04 SIGN SCHEDULE

- A. Interior Panel Signs: Provide where indicated and where required by code.
 - 1. Toilet 107, Toilet 203, Janitor 105, Stair 109,
- B. Client Logo Sign – Matte Black: Lobby 100 (11) symbols total
- C. Interior Panel Signs:
 - 1. Toilet 107 & 203
 - a. Lock door while in use

END OF SECTION 104310

SECTION 105200 - FIRE-PROTECTION SPECIALTIES

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. Portable fire extinguishers.
 - 2. Fire-protection cabinets for portable fire extinguishers.
 - 3. Mounting brackets
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for fire-stopping sealants at fire-rated cabinets.
 - 2. Division 9 painting Sections for field painting fire-protection cabinets.

1.03 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- C. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

- D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.05 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.06 SEQUENCING

- A. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: **ASTM B 209** (ASTM B 209M).
 - 2. Extruded Shapes: **ASTM B 221** (ASTM B 221M).
- C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.02 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Amerex Corporation.
 - 2. JL Industries, Inc.
 - 3. Larsen's Manufacturing Company.
 - 4. Potter Roemer; Div. of Smith Industries, Inc.
- B. General: Provide 3 fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
- C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated , with monoammonium phosphate-based dry chemical in enameled-steel container in the following nominal capacities:
 - 1. Provide 2-A: 10-B:C, **5-lb** .

2.03 FIRE-PROTECTION CABINET

- A. Products:
 - 1. JL Industries, Inc.; Ambassador Series.

2. Larsen's Manufacturing Company; Architectural Series.
3. Potter Roemer; Div. of Smith Industries, Inc.; Alta Series.

- B. Cabinet Type: Suitable for fire extinguisher.
- C. Cabinet Construction: Non rated and 1-hour rated as required for wall construction where cabinet is located.
- D. Cabinet Material: Enameled-steel sheet.
1. Shelf: Same metal and finish as cabinet.
- E. Semi recessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
1. Rolled-Edge Trim: **2-1/2-inch (64-mm)** backbend depth.
- F. Cabinet Trim Material: Steel sheet.
- G. Door Material: Steel sheet.
- H. Door Style: Vertical duo panel with frame.
- I. Door Glazing: Tempered float glass (clear).
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
1. Provide manufacturer's standard.
 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- K. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- L. Finishes:
1. Steel: Factory primed for field painting.

2.04 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Construct fire-rated cabinets with double walls fabricated from **0.0428-inch- (1.1-mm-)** thick, cold-rolled steel sheet lined with minimum **5/8-inch- (16-mm-)** thick, fire-barrier material.
 - a. Provide factory-drilled mounting holes.

- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum $1/2$ inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.05 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.

2.06 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
 - 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semi recessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare recesses for semi recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire-Protection Cabinets: **54-inches (1372 mm)** above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated, or if not indicated, as directed by Architect.
- D. Identification: Apply vinyl lettering for wall mounted fire extinguishers at locations indicated.

3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 105200

SECTION 108010 - TOILET AND BATH ACCESSORIES

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 toilet and bath accessories. Extent of each type is indicated on Drawings.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for concealed wood blocking to support accessories.

1.03 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
- B. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- C. Shop Drawings: Include blocking locations and mounting heights identified.

Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
- B. Insofar as possible, fitting, construction and fabrication of the work shall be executed at shops, ready for delivery and erection at buildings.
- C. Provide all holes, connections, and fastenings for and to work of other trades abutting, adjoining or intersecting work of this Section.

1.05 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.06 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
 - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 TOILET ACCESSORIES

- A. Products: General
 - 1. Manufacturer: Bobrick, or Bradley meeting specified requirements.
 - 2. Style: Contura.
 - 3. Mounting: Concealed.
 - 4. Keying: All keyed alike.
 - 5. Finish: Satin stainless steel.
- B. Paper Towel Dispenser, Surface Mounted: Bobrick B-4262, Type 304 stainless-steel paper towel dispenser, all welded construction, sized for minimum of 400 C-fold or 525 multifold paper towels without using special adapters; curved front with radius corners, continuously hinged front equipped with tumbler lockset; and with refill indicators that are pierced slots at sides or front.
- C. Toilet Tissue Dispenser, Surface Mounted: Bobrick B-4288 concealed mounting, curved front with radius corners, stainless-steel roll-in-reserve dispenser with hinged front secured with tumbler lockset with noncontrol delivery with manufacturer's standard theft-resistant spindle designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter-core tissue rolls.

- D. Sanitary Napkin Disposal Unit, Surface-Mounted: Bobrick B-270, stainless-steel sanitary napkin disposal unit with seamless exposed walls; curved front with radius corners; stainless-steel, continuous hinge.
- E. Grab Bar: Bobrick B-6806 Series, 1-1/2 inch diameter.
 - 1. Sizes and Configurations: As indicated.
- F. Mirror: www.wineenthusiast.com/reclaimed-barrel-head-mirror.asp. Reclaimed barrel head mirror: 24" diameter, handcrafted.
- G. Liquid Soap Dispenser, Wall-Mounted: Bobrick B-4112 surface-mounted soap dispenser, container body and back Type 304 stainless steel, satin finish. Shall dispense soaps, lotions and detergents, 40 fl. oz. capacity, unbreakable refill window, concealed wall fastening, large locked hinged stainless steel filler top, vandal-resistant.
- H. Surface Mounted Soap Dish: Bobrick B-6807 surface mounted soap dish.

2.03 CUSTODIAL ACCESSORIES

- A. Mop and Broom Holder with Utility Shelf: 30-inch (760-mm) long unit unless indicated otherwise, fabricated of minimum nominal 0.05-inch- (1.3-mm-) thick stainless steel with shelf, 8 inches deep; support brackets for wall mounting; two hooks for wiping rags; three spring-loaded, rubber hat, cam-type, mop/broom holders. Provide in each Janitor Closet and where indicated.
 - 1. Products:
 - a. Bobrick Washroom Equipment, Inc.; Model B-224 or Bradley meeting specified requirements.

2.04 FABRICATION

- A. Sections and shapes shall be rolled, formed, drawn, or extruded as required for respective functions.
- B. Molded work shall have sharply defined profile and shall be clean and straight. Plain work shall be leveled, straight and surfaces true and smooth. Edges, angles, and corners shall be square, clean and sharp, unless otherwise detailed.
- C. Fastenings, exposed metal fastenings, and accessories, unless Underwriters prohibit for safety, shall be of same materials, texture, color and finish as the base metal to which applied.
- D. Molds, trim, frames and other metalwork shall be proper dimensions to receive masonry block and tile, plaster, ceramic tile, or other scheduled finishes.
- E. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab bars shall be screwed to solid blocking in stud partitions. Install grab bars to withstand a downward load of at least **250 lbf (1112 N)**, when tested according to method in ASTM F 446.
- C. Concealed Blocking: Provide concealed wood blocking, 3/4-inch thick plywood covering 32 inch by 32 inch area, in stud walls for toilet accessories.

3.02 TOILET ACCESSORIES SCHEDULE

- A. Toilet 107:
 - 1. Provide mirror over lavatory.
 - 2. Provide paper towel dispenser.
 - 3. Provide soap dispenser and soap dish.
 - 4. Provide one toilet tissue dispenser.
 - 5. Provide grab bars where indicated.
 - 6. Provide one sanitary napkin disposal unit.
- B. Toilet 203:
 - 1. Provide mirror over lavatory
 - 2. Provide paper towel dispenser
 - 3. Provide soap dispenser and soap dish
 - 4. Provide one toilet tissue dispenser
 - 5. Provide grab bars where indicated.
 - 6. Provide one sanitary napkin disposal unit
- C. Janitor 105:
 - 1. Provide one mop/broom holder.

3.03 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 108010

SECTION 108500 - BUILDING SPECIALTIES

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. Key protection box (Knox box).
 - 2. Awning.
- B. Related Sections include the following:
 - 1. Division 6 Section Division 26 Sections for concealed blocking required to install building specialties.
 - 2. Division 9 Section "Painting" for field painting of louvers.
 - 3. Division 22/27 Sections for systems attached to structure.

1.03 SUBMITTALS

- A. General: Submit in accordance with Section 103300.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and method of attachment for each product indicated.
- C. Shop Drawings: Show fabrication and installation details for each product specified. Shop Drawings shall indicate materials, gauges, fabrication details, dimensions and method of attachment.
- D. Maintenance Data: For all items to include in Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures".

1.04 WORKMANSHIP

- A. Materials, devices, equipment and apparatus of a patented or of a special nature of manufacture shall be prepared, applied, or installed in strict accordance with the manufacturer's directions.
- B. Work of this Section shall be executed in strict accordance with Drawings, approved Shop Drawings and approved samples.
- C. Insofar as possible, fitting, construction and fabrication of the work shall be executed at shops, ready for delivery and erection at buildings.
- D. Provide all holes, connections, and fastenings for and to work of other trades abutting, adjoining, or intersecting work of this Section.

- E. All items, which do not have a special finish or are not otherwise specified, shall receive one shop coat of metal primer before leaving shop.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for manufacturer and product selection:
 - 1. Product: Subject to compliance with requirements, provide one of the products specified.

2.02 KEY PROTECTION BOX (KNOX BOX)

- A. Key Protection Box: Recessed finish to be selected by Architect. Coordinate order placement with Fire Department authorization. Coordinate mounting height and location in field with Architect.
 - 1. Product: Knox Company; Knox Box, Series 4400.

2.03 PRODUCTS

- A. Awning: Design by Leavitt & Paris
 - 1. Location: Middle Street elevation

2.04 FABRICATION

- A. General: Materials shall be free from defects impairing strength, durability or appearance.
- B. Sections and shapes shall be rolled, formed, drawn or extruded as required for respective functions.
- C. Molded work shall have sharply defined profile and shall be clean and straight. Plain work shall be leveled, straight and surfaces true and smooth. Edges, angles, and corners shall be square, clean and sharp, unless otherwise detailed.
- D. Fastenings, exposed metal fastenings, and accessories, unless Underwriters' prohibit for safety, shall be of same materials, texture, color and finish as the base metal to which applied.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installers present, for compliance with requirements for installation tolerances, and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. All items specified under this Section shall be installed in strict accordance with manufacturer's recommendations and approved Shop Drawings.

3.03 CLEANING AND PROTECTION

- A. Clean building specialties in accordance with manufacturer's instructions. Touch up factory-applied finishes to restore damaged or soiled areas.
- B. Provide final protection and maintain conditions that ensure building specialties are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 108500

SECTION 114510 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Cooking equipment, including microwave ovens.

1.2 SUBMITTALS

- A. Product Data: For each appliance type required indicating compliance with requirements. Include complete operating and maintenance instructions for each appliance.
- B. Appliance Schedule: Submit schedule of appliances, using the same room designations shown on Drawings.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the residential appliance manufacturer for both installation and maintenance of appliances required for this Project.
- B. Source Limitations: Obtain residential appliances through one source from a single manufacturer.
 - 1. Provide products from the same manufacturer for each type of appliance required.
 - 2. To the greatest extent possible, provide appliances by a single manufacturer for entire Project.
- C. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of residential appliances and are based on the specific types and models indicated. Other manufacturers' appliances with equal performance characteristics may be considered. Refer to Division 1 Section "Product Requirements."
- D. Electrical Appliances: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- E. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
- F. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the Federal Trade Commission.

1.4 DELIVERY

- A. Deliver appliances only after utility rough-in is complete and construction in the spaces to receive appliances is substantially complete and ready for installation.

1.5 WARRANTIES

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranties: Written warranties, executed by manufacturer of each appliance specified agreeing to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
 - 1. Microwave Oven: 10-year limited warranty for in-home service on defects in the magnetron tube.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, appliances that may be incorporated into the Work include, but are not limited to, those indicated in the following paragraphs of Part 2.

2.2 RESIDENTIAL APPLIANCES

- A. Microwave Oven: Listed by UL, and complying with the following requirements:
 - 1. Product: GE® 1.1 Cu. Ft. Countertop Microwave Oven
 - a. Model: PEM31EFES-Slate
 - b. Dimensions: 24" x 12" x 13".
 - 2. Type: Countertop, 1.1 cu. ft. capacity microwave oven with 1100 Watts.
 - a. Controls: Sensor Cooking controls
 - b. Clock Type: Digital
 - 3. Standard features include the following:
 - a. Automatic defrost
 - b. Child lockout feature
 - c. Instant On/Off
 - 4. Optional features include the following:
 - a. Turntable: On/Off.
- B. Refrigerator: UL Listed/Energy Star Appliance complying with the following requirements:
 - 1. Product: GE® Energy Star 21.0 Bottom-Freezer Refrigerator.
 - a. Model: GDE21EMKES Color: Slate
 - b. Dimensions: 29-3/4" x 69-7/8" x 36-5/8".
 - 2. Type: Bottom-Freezer Frost Free
 - a. Capacity: 6.1 cu. ft.
 - 3. Standard features:

- a. Beverage feature wide slide-out can dispenser.
 - b. Defrost manual.
 - c. Freezer ice tray.
 - d. 4 split adjustable, spill-resistant shelves
 - e. 3 Fixed Fresh Food Door Bins (2 with Gallon storage)
- C. Dishwasher: UL Listed/Energy Star Appliance complying with the following requirements:
1. Product: GE Built-In Dishwasher
 - a. Model: GDF6SOSMJES / Color: Slate.
 - b. Dimensions: 23-3/4" x 3/4" x 24".
 2. Type: Built-In
 3. Standard features:
 - a. Turn-to-Start Front Controls
 - b. Cycle progress indicator
 - c. Lift-out water filtration system
 - d. No. of Cycles = 7
 4. Options:
 - a. Heater Dry On/Off
- D. Under Counter Refrigerator: Provide freestanding, under counter refrigerator. Auto defrost, tight seal to lock in freshness, adjustable temperature control.
1. Capacity: Provide the following minimum values, measured according to ANSI/AHAM HRF-1 and certified by AHAM:
 - a. Total Volume: 5.7 cu. ft.
 2. Temperature Controls: Include dual knob/single thermostat.
 3. Color: Stainless Steel.
 4. Location: Lobby100
 5. Model #KURS24LSBS
 6. Quantity: 1

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing, mechanical, and electrical services, with Installer present, to verify actual locations of services before residential appliance installation.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Utilities: Refer to Divisions 15 and 16 for plumbing and electrical requirements.

3.3 ADJUSTING AND CLEANING

- A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
- B. Verify that accessories required have been furnished and installed.
- C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

END OF SECTION

SECTION 124813- FLOOR MATS AND FRAMES

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. Entrance mats.
 - 2. Vinyl Edge Walk-Off Mats.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for slab depression grouting and filling for recessed foot grilles and frames.

1.03 SUBMITTALS

- A. General: Submit in accordance with Section 01330.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: For floor mats, foot grilles, and frames. Show assembly, joint locations, installation details, layout, plans, elevations, sections, accessories, anchors, and attachments to other Work.
 - 1. Coordinate Shop Drawings showing oversized recess for deferred installation of frames with concrete work.
- D. Maintenance Data: For floor mats to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain floor mats, foot grilles, and frames through one source from a single manufacturer.
- B. Accessibility Requirements: Provide installed floor mats and grilles that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.05 COORDINATION

- A. Coordinate size and location of oversized recesses in concrete work to receive foot grilles and frames. Defer frame installations until building enclosure is completed and related interior

finish work is in progress. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.01 ENTRANCE MAT EM2

- A. Carpet-type Mat, EM2: Textured loop walk off mat:
 - 1. Colors, Textures, and Patterns: As indicated by manufacturer's designations.
 - 2. Mat Size: As indicated.
 - 3. Product: J & J/Invision, Runway 7000

2.02 CARPET EM1

- A. Carpet-type Mat, EM2: 100% solution dyed UV stabilized Polypropylene fibers; carpet bonded to vinyl backing to form mats **3/8-inch** thick with **1-inch** wide vinyl edge.
 - 1. Total weight: 119 oz. / sq. yd.
 - 2. Colors, Textures, and Patterns: As indicated by manufacturer's full range.
 - 2. Mat Size: As indicated.
 - 3. Product: Pinstep; Mats Inc.

2.03 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.

2.04 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth and other conditions affecting installation of floor mats, foot grilles, and frames.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Level setting bed to receive grate with Ardex K-15. Apply Ardex to a minimum **1/8-inch** thickness over primed concrete.

3.03 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.
 1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.04 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.
- B. Defer installation of floor mats and foot grilles until Project is near Substantial Completion.

END OF SECTION 124813

Section 124940 - Bead Chain Clutch Operated FlexShades

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manually operated, roll-up fabric interior window shades including mounting and operating hardware.

1.2 RELATED SECTIONS

- A. Section - Rough Carpentry.
- B. Section - Joint Protection.
- C. Section - Gypsum Board Assemblies.

1.3 REFERENCES

- A. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.
- B. GREENGUARD Environmental Institute Children & Schools
- C. US Green Building Council.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures:
- B. Product Data: Manufacturer's data sheets on each product specified, including:
 - 1. Preparation instructions and recommendations.
 - 2. Installation and maintenance instructions.
 - 3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 4. Storage and handling requirements and recommendations.
 - 5. Mounting details and installation methods.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.
- E. Selection Samples: For each finish product specified, two complete sets of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two complete sets of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.

- G. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- H. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.
- B. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.
- D. Store products in manufacturer's unopened packaging until ready for installation.

1.7 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

- A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.9 WARRANTY

- A. Hardware and Shade Fabric: Draper's standard twenty-five year limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Draper, Inc., which is located at: 411 S. Pearl P. O. Box 425 ; Spiceland, IN 47385-0425; Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Fax: 866-637-5611; Email:drapercontract@draperinc.com; Web:www.draperinc.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 63 00.

2.2 BEAD CHAIN CLUTCH OPERATED WINDOW SHADES

- A. Manually Operated Window Shades with Independent Control: Manually operated, vertical roll-up, fabric window shade with components necessary for complete installation; Manual FlexShade as manufactured by Draper, Inc.
 - 1. Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide limit stops to prevent shade from being raised or lowered too far.
 - a. Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon.
 - b. Bead chain loop: Plastic bead chain hanging at side of window, Color as selected by Architect.
 - c. Idler Assembly: Provide roller idler assembly of molded nylon with adjustable length idler pin to facilitate easy installation, and removal of shade for service.
 - 2. Mounting:
 - a. Mounting brackets.
 - b. Endcaps.
 - 3. Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
 - 4. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.
 - a. Endcap covers: To match fascia or headbox color.
 - 5. Brackets: Plated stamped steel. Provide size compatible with roller size.
 - a. Mounted to wall.
 - 6. Headbox Ceiling/Wall style: Aluminum fabrication with removable closure, endcaps, and back and top cover piece:
 - a. Finish: Clear anodized.

2.3 FABRIC

- A. Light-Filtering Fabrics
 - 1. SheerWeave SW2600 by Phifer: VOC Emissions: GREENGUARD Certified as a low emitting fabric. Manufacturer to supply GREENGUARD Children & Schools certificate. 500 denier fiberglass, vinyl coated and woven into basket weave. Fire rating: NFPA 701. Bacteria and Fungal Resistance: ASTM G 21

2. and ASTM G 22, .024 inches thick.
 2. Light filtering shades PVC coated fiberglass yarn 10.5 oz/sq. yd.
- B. Color and pattern: Choose from full color range
- C. Room darkening Shades: Provide opaque, close woven fiberglass base textile with sun-resistant vinyl film bonded to each side; fire retardant, washable and stain resistant.
1. Product: Draper SunBloc Series SE9000
 2. Color: As selected by Architect from manufacturer's full range.
- D. Location: Provide shades at all cPort glazing locations. Refer to drawings

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.
- B. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.
- C. Coordinate installation of recessed shade pockets with construction of suspended acoustical panel ceilings specified in Section 09 51 23.
- D. Coordinate installation of recessed shade pockets with construction of suspended gypsum board ceilings specified in Section 09 21 16.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
- C. Shade pockets:
1. Install shade pockets prior to installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches (610 mm) minimum centers.
 2. Install shade pockets in conjunction with installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches (610 mm) minimum centers.
 3. Install corner pieces securely and in alignment with pockets.
 4. Install pocket ends securely and in alignment with pockets.
 5. After interior construction is essentially complete, install shade and operating mechanism in pocket.

- D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
 - 1. Fascias.
 - 2. Closure panels.
 - 3. Endcaps.

3.4 TESTING AND DEMONSTRATION

- A. Demonstrate operation of shades to Owner's designated representatives.

3.5 PROTECTION

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

3.6 SCHEDULES

- A. Refer to Drawings for shade types, locations and details.

END OF SECTION

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Bicycle racks.
- 2. Aluminum fence.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for concrete footings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 BICYCLE RACKS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Neenah Foundry Company; Bicycle Rack for Parking Meter Post or comparable product by one of the following:
 - 1. Dero "Bike Hitch Style" bike rack as indicated on the drawings.

2.2 ALUMINUM FENCE

- A. Construct from materials indicated on the drawings.
- B. Provide galvanized fasteners, unless noted otherwise.

2.3 MATERIALS

- A. Steel and Iron: Free of surface blemishes and complying with the following:
 - 1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
 - 3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
- B. Anchors, Fasteners, Fittings, and Hardware: Galvanized steel; commercial quality.
- C. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:
 - 1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
 - 2. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.4 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.5 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish (Bike Rack): Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

END OF SECTION 129300

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes hydraulic passenger, double post, holeless elevators with non-proprietary controller.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-In-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Division 05 Section "Metal Fabrications" for the following:
 - a. Hoisting beams.
 - b. Structural steel shapes for subsills at each floor.
 - c. Pit ladders.
 - d. Sump pump cover and frame.
 - e. Attachment plates, angle brackets, and other steel framing for supporting guide-rail brackets.
 - 3. Division 07 Section "Cementitious Waterproofing" for waterproofing elevator pit.
 - 4. Division 09 Section "Carpet" for finish flooring in elevator cars.
 - 5. Division 23 Sections for ventilating of hoistway and machine room.
 - 6. Division 26 Sections for electrical service to elevator, including fused disconnect switch, standby power source, transfer switch and telephone.
 - 7. Division 21 and 26 Sections for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.3 DEFINITIONS

- A. Hydraulic Elevators: Elevators in which cars are hoisted by action of a double post telescoping hydraulic cylinder (jack); with other components of the Work, including fluid storage tank, pump, piping, valves, car enclosures, hoistway entrances, operation systems, signal equipment, guide rails, electrical wiring, buffers, and devices for operations, safety, security, required performance at rated speed and capacity, and for complete elevator installation.
- B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

- A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
- B. Product Data: Include capacities, sizes, performances, operations, safety features, controls, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- C. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- D. Maintenance Manuals: Include operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01 Section "Operation and Maintenance Data."
- E. Inspection and Acceptance Certificates: Obtain and submit inspection and acceptance certificates and operating permits as required by governing authorities for normal, unrestricted elevator use.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage elevator manufacturer or an experienced Installer approved by elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain elevators from single manufacturer.
- C. Regulatory Requirements: All work shall comply with the latest edition (as of date bids are taken) of ASME A17.1 2013, Safety Code for Elevators and Escalators and the National Electrical Code.
- D. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, with ICC A117.1 and with Section 4.10 of the Uniform Federal Accessibility Standards (UFAS).
- E. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 - 2. See Structural Drawings for effective peak velocity acceleration (A_v), and earthquake spectral response acceleration period (S_d s).

3. Provide earthquake equipment required by ASME A17.1.
4. Seismic Risk Zone Category: 2A.
5. Elevator Component Importance Factor: 1.5.

- F. In the interest of unified responsibility, Elevator package shall be a nationally recognized United States company regularly engaged in the business of manufacturing elevators of type and character required by these Specifications, and shall manufacture entire power unit, controller, hydraulic cylinder and all other parts of the equipment, including door operators and signal fixtures, and shall so state in his request for approval listing the items he manufactures.
- G. Design for Maintenance Requirements: Installation shall be a design that can be maintainable by any licensed elevator maintenance company employing journeymen mechanics, without need to purchase or lease additional diagnostic devices, special tools, or instructions from original equipment manufacturer.

1.6 COORDINATION

- A. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders and sumps; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Manufacturer's Warranty: Submit a written warranty signed by manufacturer agreeing to repair, restore, or replace defective elevator work within 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide high frequency use hydraulic elevators by one of the following:
1. Canton Elevator Co.; local distributor, Pine State Elevator, phone: (800) 627-9706.
 - a. Elevator sized to accept IBC 2006 & Later 84" x 24" stretcher.

2.2 DESCRIPTION OF EQUIPMENT

- A. Passenger Elevators:
1. Capacity: 3500 lbs. minimum.
 2. Speed: 125 feet per minute full load up.
 3. Operation: Selective collective.
 4. Clear Car Inside: 80 inches wide by 64 inches deep.

5. Travel: 22 feet 2 inches ±.
6. Power Supply: 208 volts - 3 phase - 60 cycles 40HP.
7. Stops and Openings: Front, 4 stops.
8. Door Size and Type: 42 inches by 84 inches, single slide.
9. Door Operation: D.C. Power Operation.
10. Signals: Illuminated buttons, alarm bell, position indicator in car with audible signal, hall lantern and gong, with position indicator at main landing, brushed stainless steel.

11. Special Features: Infrared light beam door protection system for full height of door, handicapped requirements, fire-fighters service, emergency lighting with power pack. Provide controller compatible with emergency generator for emergency back-up power.

12. Motor: 40 HP maximum. Include closed transition solid state starting.

Note: Manufacturer providing elevator motor with greater H.P. shall be responsible for cost of upgrading disconnect and wiring.

13. Provide access control at each stop.

2.3 PASSENGER ELEVATOR CAR ENCLOSURES

- A. General: Provide manufacturer's standard car enclosures of the selections indicated. Include ventilation, lighting, access doors, doors, power door operators, sills (thresholds), trim, accessories, and wall and ceiling finishes. Provide manufacturer's standard flush-panel horizontal-sliding doors of type indicated. Provide manufacturer's standard protective edge trim system for door and wall panels, except as otherwise indicated.
- B. Materials and Fabrication: Provide selections indicated or, if not otherwise indicated, manufacturer's standard welded steel construction with factory finish of synthetic enamel, and provide other materials and fabrication of not less than the following:
 1. Walls: Flush wall plastic laminate pressure bonded to a wood core with a fire-retardant backing sheet.
 2. Canopy: #4 Stainless modular panels in an aluminum grid, stainless steel return.
 3. Front and Transom: Brushed stainless steel.
 4. Doors: Hollow metal construction, brushed stainless steel.
 5. Ceiling and Lighting: Stainless steel with LED disk lighting.
 6. Sill: Aluminum.
 7. Flooring: Carpet specified in Division 09 Section "Carpet."
 8. Handrails: Cylindrical metal bar, brushed stainless steel.
 9. Clear Cab Height: 88 inches.
 10. Accessories: Two-speed exhaust fan, brushed stainless steel certificate frame, and ADA compliant, two-way speakerphone, protection pads and stainless steel pad buttons.

2.4 PASSENGER HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard hollow-metal, sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Match car doors for size, number of panels, and door movement. Provide frame size and profile to coordinate with hoistway wall construction.
- B. Materials and Fabrication: Provide the following materials and finishes for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment; provide manufacturer's standards, but not less than the following:
1. Satin Stainless-Steel Frames: Formed stainless-steel sheet with No. 4 satin finish.
 2. Satin Stainless-Steel Panels: Flush construction with No. 4 satin finish.
 3. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch fire-retardant-treated particleboard with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels shall be removable for ease of replacement if damaged.
 4. Aluminum Sills: Extruded aluminum, with grooved surface, 1/4-inch thickness, mill finish.
 5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 for grouting door sills.

2.5 EQUIPMENT

- A. Passenger Elevator: ThyssenKrupp or Canton holeless hydraulic elevator meeting the following minimum requirements. Interior car finishes shall match those specified; failure to comply will be reason for rejection.
1. Platform and Sling: Platform shall have fabricated frame of formed and structural steel shapes, gusseted and rigidly welded. Provide fire-treated wood subfloor prepared for finish flooring. Finished flooring, installed on top of car platform, shall be provided in Division 09 Section "Carpet." Underside of platform shall be fireproofed. Sling shall consist of heavy steel channel stiles properly affixed to steel crosshead and bolster, with adequate bracing members, to remove all strain from car enclosure. Steel bumper plates shall be affixed to bottom of bolster channels, and a platen plate with clamps and cap screws shall be furnished for fastening sling to plunger.
 2. Passenger Car Doors: Car entrance shall be provided with horizontal sliding doors with panel rigidity obtained by suitable steel reinforcements. Doors shall be hung on sheave hangers with polyurethane tires and sheaves not less than 3-1/4 inch diameter, running on a polished steel track, and guided at bottom by non-metallic shoes sliding in smooth threshold groove.
 3. Alarm Bell: Emergency alarm bell shall be located in conformance with ASME A-17.1 Code requirements and connected to a plainly marked pushbutton in car. Connect alarm bell to emergency lighting power pack.
 4. Guide and Guide Shoes: Guides for elevator car shall be planed steel elevator guide rails, properly fastened to building structure with steel brackets. Car stile shall be fitted at top and bottom with guide shoes of self-aligning, swivel type, with metal body and removable, non-metallic liners.

5. Power Unit (Oil Pumping and Control Mechanism): Shall be compactly and neatly designed with all components listed below combined in a self-contained unit; structural steel outer base with tank supports; floating inner base for mounting pump assembly; oil reservoir with tank cover and controller compartment with cover; metal drip pan; oil-hydraulic pump; electric motor; oil control unit with following components built into single housing; high pressure relief valve; check valve; automatic unloading upstart valve; lowering and leveling valve; and magnetic controller. Pump shall be especially designed and manufactured for oil-hydraulic elevator service. It shall be of the positive displacement type, inherently designed for steady discharge with minimum pulsations to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on elevator car. Motor shall be especially designed for oil-hydraulic elevator service, of standard manufacture, and of duty rating to comply with herein specified speeds and loads. Oil control unit shall consist of following components, all built into single housing. Welded manifolds with separate valves to accomplish each function will not be acceptable under this Specification. All adjustments shall be accessible and shall be made without removing assembly from oil line. Relief valve shall be externally adjustable, and shall be capable of bypassing total oil flow without increasing back pressure more than 10 percent above that required to barely open valve. Up start and stop valve shall be externally adjustable, and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from jack unit, insuring smooth up starts and up stops.

Check valve shall be designed to close quietly without permitting any perceptible reverse flow. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth "Down" starts and stops. Leveling valve shall be designed to level car to floor in direction car is traveling when slowdown is initiated. Electric controller shall be microprocessor integrated circuitry. Silver to silver contacts shall be utilized on all relays and contactors (where provided). Provide thermal overload relays to protect motor. All component switches to be mounted in a steel panel designed for mounting on power unit, wall or floor.
6. Jack Unit: Shall be double post design, designed and constructed in accordance with applicable requirements of ASME A-17.1 Code. It shall be of sufficient size to lift gross load the height specified and shall be factory tested to insure adequate strength and freedom from leakage. No brittle material, such as grey cast iron, shall be used in jack construction. Jack unit shall consist of following parts: plunger of heavy seamless steel tubing accurately turned and polished; stop ring shall be electrically welded to plunger to positively prevent plunger leaving casing; internal guide bearing; packing or seal of suitable design and quality; drip ring around cylinder top; cylinder made of steel pipe and provided with pipe connection and air bleeder. Brackets shall be welded to jack cylinder for supporting elevator on pit channels. Provide auxiliary safety bulkhead in lower end of cylinder, which will limit down car speed to safe value in event of leakage around external bulkhead.
7. Mainline Strainer: Shall be self-cleaning type, equipped with 40-mesh element, for installation in oil line.
8. Automatic Guide Rail Lubricators: Shall be provided and mounted on top of upper guide shoes. Wool felt wiper shall apply an even, uniform flow of oil which shall thoroughly lubricate faces of guide rail from a leak-proof oil reservoir.
9. Failure Protection: Electrical control circuit shall be designed so if malfunction should occur, due

to motor starter failure, oil becoming low in system, or car failing to reach landing in up direction within predetermined time, elevator car will automatically descend to lowest terminal landing. If power operated doors are used, doors shall automatically open when car reaches landing to allow passengers to depart. Doors shall then automatically close and all control buttons, except "Door Open" button in car station, shall be made inoperative.

10. Sound Insulation Panels: Shall be manufactured of reinforced 16-gage steel with a 1-inch thick, 1-1/2 lb. core of fiberglass affixed to interior. Mount on all four open sides of power unit frame.
11. Sound Isolating Couplings: Provide a minimum of two installed in oil line in Machine Room between pump and jack.
12. Oil-Hydraulic Silencer (Muffler Device): Shall be installed in oil line near power unit. It shall contain pulsation-absorbing material inserted in blowout-proof housing arranged for inspecting interior parts without removing unit from oil line. A rubber hose without blowout-proof features will not be acceptable.
13. Vibration Pads: Mount under power unit assembly to isolate unit from building structure.
14. Automatic Terminal Limits: Electric limit switches, placed in hatchway near terminal landings, shall be designed to cut off electric current and stop car should it run beyond either terminal landing.
15. Automatic Self-Leveling: Provide elevator with self-leveling feature that will automatically bring the car to floor landings. Self-leveling shall, within its zone, be entirely automatic and independent of operating device, and shall correct for overtravel or undertravel. Car shall also be maintained approximately level (within 1/2-inch) with landing irrespective of load.
16. Buffers: Provide buffers, complying with requirements of ASME A-17.1, under car in elevator pit. Mount buffers on continuous channels fastened to elevator guide rail or securely anchored to pit floor; provide substantial extensions, if required.
17. Car Top Inspection Station: Provide station with "emergency stop" switch and with constant pressure "up-down" direction buttons, which make normal operating devices inoperative and give inspector complete control of elevator.
18. Door Operation: Provide direct current motor-driven, heavy-duty operator designed to operate car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and door operating mechanism shall be arranged for manual operation in event of power failure. Provide full height, infrared light beam door sensing device with automatic non-contact reversal of car and hoistway doors if obstruction enters path of travel for passenger elevators. Doors shall then resume closing cycle. Doors shall automatically open as car arrives at landing and shall automatically close after an adjustable time interval or when car is dispatched to another landing. Direct drive geared operators, AC controlled units with oil checks, or other deviations from above are not acceptable.
19. Interlocks: Each hoistway entrance shall be equipped with approved type interlock tested as required by code. Interlock shall be designed to prevent operation of car away from landing until doors are locked in closed position as defined by code. Interlock shall prevent opening of doors at any landing from corridor side unless car is at rest at that landing or is in leveling zone and is stopping at that landing. Interlocks shall bear Underwriters' Laboratories "B" label of approval.
20. Hoistway Door Unlocking Device: As specified by ASME A-17.1, shall be provided to permit authorized persons to gain access to hoistway when elevator car is away from landing.
21. Door Hangers and Tracks: For each hoistway sliding door, provide sheave type two-point suspension hangers and tracks complete. Sheaves shall be 3-1/4 inches in diameter and have polyurethane tires with ball bearings properly sealed to retain grease. Hangers shall have adjustable slide to take up-thrust of doors. Tracks shall be drawn steel shapes with smooth

surfaces and shaped to conform to hanger sheaves.

22. Passenger Hoistway Entrances: Shall be hollow metal, horizontal sliding type provided complete at each hoistway opening. Entrances shall be manufacturer's standard design bearing Underwriters' Laboratories' "B" labels. They shall consist of frames, sills, doors, hangers, hanger supports, hanger covers, fascia plates, and all necessary hardware. Entire front wall of hoistway shall be left open or a rough opening provided which is 18 inches greater in width and 12 inches greater in height than finished opening, until after entrances are installed. After guide rails are set and lined, install entrance frames in perfect alignment with guide rails. Finish walls shall then be completed by others.
23. Passenger Operation (Selective Collective Automatic Pushbutton): Control of elevator car shall be automatic in operation by means of pushbutton with security provisions to enable card reader lockouts to limit access to upper floors in car marked for each landing level served, an "up-down" button at each intermediate landing, and a call button at each terminal landing, wherein all stops registered by momentary pressure of landing or car buttons shall be maintained until car answers call. Provide emergency stop switch in car pushbutton station, which, when in off position, will render elevator inoperative, and which will enable attendant or passenger to stop car at any point during its travel. Opening of this switch shall not cancel registered calls, and when switch is closed, car will continue to answer calls that have been registered. Each landing station shall contain an illuminated pushbutton, which shall "light up" when pressed to indicate that a call has been registered to bring car to that particular landing. A time delay, noninterference feature, shall be incorporated in control mechanism to allow ample time for opening and closing car and hoistway doors before it is again placed in motion.

2.6 SIGNAL EQUIPMENT

- A. General: Provide signal equipment for each elevator with hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, non-yellowing translucent plastic.
- B. Car Control Stations: Provide manufacturer's standard semi-recessed car control stations. Mount in return panel adjacent to car door, if not otherwise indicated.
 1. All floor buttons shall be no higher than 48 inches above finish floor to comply with UFAS standards, unless there is a substantial increase in cost, in which case the maximum mounting height may be increased to 54 inches above finish floor.
- C. Emergency Communication System: Provide system that complies with ASME A17.1, U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)," and Section 4.10 of the Uniform Federal Accessibility Standards (UFAS). On activation, system shall dial preprogrammed number of monitoring station and identify elevator location to monitoring station. System shall provide two-way voice communication without using handset and provide visible signals that indicate when system has been activated and when monitoring station has responded. Provide system contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Fire Department Communication System: Provide in each car and required conductors in

traveling cable for fire department communication system specified in Division 26 Sections.

- E. Car Position Indicator: For passenger elevator cars, provide illuminated-signal type, digital-display type, or segmented type, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
 - 1. Include travel direction arrows if not provided in car control station.
- F. Hall Push-Button Stations: Provide hall push-button stations at each landing for elevator.
 - 1. Provide units with flat faceplate, not less 3/4-inch diameter, satin stainless steel for mounting with body of unit recessed in wall.
 - 2. Provide units with direction-indicating buttons; two buttons at intermediate landings; one button at terminal landings.
- G. Hall Lanterns: Provide units with illuminated arrows, but provide single arrow at terminal landings.
 - 1. Provide units with flat, satin stainless steel faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
 - 2. Place lanterns either above or beside each hoistway entrance, unless otherwise indicated. Mount at a minimum of 72 inches above finished floor.
 - 3. With each lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- H. Hall Position Indicators: Provide illuminated-signal type or digital-display type, located above each hoistway entrance at main floor landing. Provide units with flat, satin stainless steel faceplate for mounting with body of unit recessed in wall.
 - 1. Integrate hall lanterns with hall position indicators.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of elevator work. Examine hoistways, hoistway openings, pits, and machine rooms, as constructed. Verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
 - 1. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance of work.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations.
- B. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure

dimensional coordination of the Work.

- C. Install cylinders for holeless elevator plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- D. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- E. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby, eliminate sources of structure-borne noise from elevator system.
- F. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent cement fittings.
- G. Lubricate operating parts of systems as recommended by manufacturers.
- H. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- I. Leveling Tolerance: 1/4-inch, up or down, regardless of load and direction of travel.
- J. Set sills flush with finished floor surface at landings. Fill space under sills solidly with nonshrink, nonmetallic grout.
- K. Wiring, Piping and Oil: All necessary wiring shall be furnished and installed in the hoistway in accordance with the National Electrical Code, to connect the operating buttons and switches to the control board in the power unit. All wiring shall be in rigid conduit or electric metallic tubing except to movable apparatus, which shall be connected by short lengths of flexible conduit. Provide all necessary pipe and fittings to connect the power unit to jack unit and oil in proper grade. All underground conduit and piping shall be adequately protected against corrosion.
- L. Controls: Shall be placed for convenient use of wheelchair operators as required by the State Handicapped Code.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: Upon nominal completion of elevator installation, and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by the ASME A17.1 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

- C. In addition to other requirements, inspections, tests and remedies herein provided, upon completion of elevator installation and before final approval and final payment, the Elevator Subcontractor shall make, in the presence of the Architect or his designated representative, a running speed test with full maximum load on the elevator car to determine whether the elevator equipment, as installed, meets the speed, capacity and all other requirements of the Specifications.
- D. In the event the equipment does not meet all requirements of the Specifications, Elevator Subcontractor shall promptly remove from premises, all work condemned by Architect as failing to conform to Contract, and shall promptly replace and re-execute work in accordance with Contract without expense to Owner. Elevator Subcontractor shall bear all expense of making good all work of other Contractors destroyed or damaged by such removal or replacement.
- E. Obtain State of Maine elevator inspection certificate.

3.4 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete elevator maintenance program. Coordinate instruction with the availability of the Owner's personnel.
- B. Make a final check of each elevator operation with Owner's personnel present and just prior to date of Substantial Completion. Determine that operation systems and devices are functioning properly.

3.5 PROTECTION

- A. Temporary Use: Do not use elevators for construction purposes.
- B. Provide protective coverings, barriers, devices, signs, and other procedures to protect elevator. If, despite such protection, elevator becomes damaged, engage elevator Installer to restore damaged work so no evidence remains of corrective work. Return items that cannot be refinished in field to shop, make required repairs and refinish entire unit, or provide new units as required.
- C. Provide final protection and maintain conditions, in a manner acceptable to elevator manufacturer and Installer that ensure elevators are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 142400

SECTION 211000 - FIRE-SUPPRESSION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The fire protection system shall be an automatic sprinkler system arranged to properly protect the building and shall meet NFPA 13, local, and State requirements.
- B. This Section includes fire-suppression sprinklers, piping, and equipment.
- C. The Sprinkler Contractor shall place the sprinkler system in service and hand over the sprinkler system to the General Contractor for care and maintenance.
- D. Performance and Design Criteria: Provide products and systems complying with specific performance and design criteria indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design sprinklers and obtain approval from authorities having jurisdiction. The design of the automatic sprinkler system shall be complete with all necessary accessories for proper operation.
- B. The system shall be hydraulically calculated in accordance with all provisions of the Contract Documents and any authority having jurisdiction.
- C. The contract documents do not include a fire pump. Provide over-sized piping as required to meet required system hydraulics. Contractor shall review the civil plans, the existing site and existing fire flow data. If the contractor or authority with jurisdiction determines that a fire pump is required: Provide in accordance with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.
- D. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
 - 1. Include a 5 percent margin of safety for available water flow and pressure.
 - 2. Include losses through water-service piping, valves, and backflow preventers.

- E. Sprinkler Occupancy Hazard Classifications:
 - 1. Light Hazard:
 - a. Office and Public Areas
 - b. Corridors
 - 2. Ordinary Hazard, Group 1:
 - a. General Storage Areas
 - b. Mechanical Equipment Rooms
 - c. Building Service Areas.
 - d. Electrical Equipment Rooms
- F. Minimum Density for Automatic-Sprinkler Piping Design shall be in accordance with NFPA 13. Maximum Protection Area per Sprinkler shall be in accordance with NFPA 13.

1.4 GENERAL REQUIREMENTS

- A. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.
- B. Protect all systems from freezing. Provide freeze protection for sprinklers in any unheated areas with a dry pipe system.
- C. Bundled/Grouped wired in concealed spaces: Non-combustible spaces having 15 or more non-plenum-rated wires grouped together shall be fully sprinklered.
- D. Seismic Performance: If required by the authority with jurisdiction, fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.
 - 1. Seismic-Restraint Loading: Refer to Structural Drawing S000, A1.
- E. Elevators: Provide sprinkler protection in accordance with authority with jurisdiction requirements.
- F. Coordinate fire department connection type and location with local fire department.
- G. The sprinkler contract starts inside the sprinkler valve room with a connection to the water entry. Coordinate with the site contractor.
- H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 7 for materials. Seal all penetrations through fire-or smoke-rated wall, partition, ceiling, or roof assemblies with firestopping system. Refer to Architectural plans for location of rated assemblies.
- I. Contractor shall obtain and pay for required permits.

1.5 SUBMITTALS

- A. Shop Drawings: Submit working plans, prepared according to NFPA 13, and hydraulic calculations with cross reference to applicable drawings, water supply data, and equipment schedule with ratings for the system to the Owner's Representative, Insurance Underwriter, and other authorities having jurisdiction.
- B. Product Data: Catalog sheets, specifications, and installation instructions. Indicate UL or FM approval for each product. Include the following additional information:
 - 1. Pipe and fitting materials and methods of joining for sprinkler piping.
 - 2. Pipe hangers and supports.
 - 3. Piping seismic restraints.
 - 4. Valves, including specialty valves, accessories, and devices.
 - 5. Alarm devices. Include electrical data.
 - 6. Electrical Devices: Complete description of intended use, wiring diagrams, data plate information and, in the case of switching devices, whether normally on or normally off. .
 - 7. Mechanical Devices: Complete description of intended use, including normal operating capacities and working pressures.
 - 8. Enclosures: Dimensions, materials, gages of metals; type of door hinges and locks, and methods of securing the enclosure members to the building construction.
 - 9. Hose Threads: Verify that hose threads on fire department connections match threads on equipment used by the local or servicing fire department.
- C. Design Data: The portions of the sprinkler system not sized on the Contract Drawings shall be sized in accordance with NFPA requirements for Hydraulically Designed Systems. Submit drawings and hydraulic calculations for approval.
- D. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible sprinkler system design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Certification: Submit Contractor's NICET certification and number or PE license number.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- F. Maintenance Data: For each type of sprinkler specialty to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

- A. Sprinkler Contractor
 - 1. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.

2. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified sprinkler designer. Base calculations on results of fire hydrant flow test. Sprinkler designer shall be legally qualified and licensed to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.
3. Contractor shall be a licensed fire sprinkler contractor.

B. Manufacturer Qualifications:

1. Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.
2. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
4. Factory Mutual Engineering Corporation (FM) Approval Guide

C. NFPA Requirements: Year edition per authority of jurisdiction.

1. NFPA#1 Fire Prevention Code
2. NFPA #13 "Standard for the Installation of Sprinkler Systems".
3. NFPA #14 Standard for the Installation of Standpipe, Private Hydrants and Hose Systems
4. If a fire pump is required: Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.
5. NFPA 291: Recommend Practice for Flow Testing and Marking of Hydrants

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8.

1.8 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. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space for a minimum of six spare sprinklers plus sprinkler wrench. Include the number of sprinklers required by

NFPA 13 and wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 PIPING

- A. Pipe and fittings shall conform to the requirements of NFPA 13. Pipe shall be listed by UL and be FM approved, and installed per its listing and approval.
- B. Sprinkler piping shall be black steel schedule 40 for 2 inch and smaller, and thinwall for 2 ½ inch and larger. C factor 120.
- C. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in N.F.P.A. 13. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application.

2.2 JOINING MATERIALS

- A. Furnish in accordance with NFPA 13.
- B. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.3 SPRINKLERS

- A. Fire sprinklers shall be of one manufacturer throughout the building. No mixing of sprinkler brands shall be permitted. Sprinklers shall be of all brass frame construction with a quick response frangible bulb type fusible element.
- B. Automatic Sprinklers: With U.L. listed heat-responsive elements.
- C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- D. Provide quick response sprinklers.
- E. Institutional Semi-Recessed or "Vandal-Resistant" sprinkler heads as required by application.
- F. Sprinkler Escutcheons: Materials, types, and finishes of sprinklers. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.4 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
- F. Dry-Pipe-System Fittings: UL listed for dry-pipe service.
- G. Provide flexible sprinkler hose with fittings intended for use in sprinkler systems between the branch line and sprinkler. Provide in accordance with NFPA 13 and the manufacturer's installation instructions. Length: 38".
 - 1. U.L. 2443 listed for sprinkler hose application.
 - 2. Flexible Hose: Corrugated Stainless Steel AISI 304
 - 3. Slip Nuts: Brass C3771BC
 - 4. Reducer Fitting: Yellow Zinc/Steel SPPS
 - 5. Special Shoulder Nipple (Inlet): Yellow Zinc/Steel SPPS
 - 6. Reducing Nipple Clamp & Bolt: Galvanized Steel SS41
 - 7. Maximum Working Pressure of Flexible Connection: 200 PSI
 - 8. Test Pressure of Flexible Connection: 400 PSI
 - 9. Maximum Temperature Rating of Flexible Connection: 300 °F
 - 10. Provide ceiling bracket.

2.5 VALVES

- A. Valves shall be UL listed and FMG approved
- B. System Control Valve: The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and Factory Mutual Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI.
- C. Manual or automatic air venting valve to exhaust trapped air in the wet sprinkler system.

2.6 WATERFLOW ALARMS

- A. Flow of water equal to or greater than that from a single automatic sprinkler (smallest orifice in system) shall result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops.

- B. The alarm apparatus shall consist of a listed alarm check valve or other listed waterflow-indicating device with the necessary attachments to give an alarm.
- C. The apparatus for a dry pipe system shall consist of alarm attachments to the dry pipe valve.

2.7 FIRE DEPARTMENT CONNECTION

- A. A system fire department connection shall be provided on the system riser in accordance with NFPA 13. Fire department connection shall be UL Listed and Factory Mutual Approved for fire protection use.
- B. Cast brass body, brass clapper inlets, brass plate, adapters and plugs with chain.
- C. Include inlets with threads according to NFPA 1963 and local fire department requirements.
- D. Provide escutcheon plate and labeling per NFPA 13.

2.8 BACKFLOW PREVENTION

- A. Provide in accordance with manufacturers recommendations.
- B. Provide in accordance with NFPA 13. Provide a permanent means of testing the backflow preventer in accordance with NFPA 13 requirements.
- C. Backflow preventer types; provide as required by the local water district.
 - 1. Double check: Watts Series 709DCDA or 774DCDA detector check fire service applications; or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 EXISTING SYSTEMS

- A. Refer to Division 1 demolition requirements and procedures. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.

3.3 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 31 for exterior piping.

- B. Comply with NFPA 24 for fire-service-main piping materials and installation.
- C. Provide ductile-iron, water-service piping according to AWWA C600 and AWWA M41. Provide underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports. Install sleeve seals for piping penetrations of concrete walls and slabs.
- D. Provide shutoff valve, pressure gage, drain, and other NFPA-required accessories at connection to water-service piping.
- E. Provide backflow prevention as required by the local water district.

3.4 PREPARATION

- A. The nature of the work requires coordination with other trades. Shop fabrication shall be done at the Contractor's risk. Relocation of piping and components to avoid obstructions may be necessary. Relocation, if required, shall be done at the Contractor's expense. The installation shall be performed in a workmanlike manner as determined by the Owner's Representative and in accordance with the Contract Documents, manufacturer's printed installation instructions, and submitted and Owner's Representative reviewed drawings.

3.5 SPRINKLER APPLICATIONS

- A. General: Use sprinklers according to the following applications:
 - 1. Rooms/spaces without Ceilings: Upright sprinklers.
 - 2. All occupied rooms with Finished Ceilings: Concealed with round flat cover.
 - 3. Provide sprinkler guards for heads in mechanical and storage spaces, less than 8 ft. above finished floor subject to mechanical damage.
 - 4. Electrical or Data Rooms with finished ceilings: Concealed
 - 5. Electrical or Data Rooms without ceilings: Provide guard
 - 6. Attics: attic sprinklers.
 - 7. Wall Mounting: Sidewall sprinklers.
 - 8. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
 - 9. Special Applications: Use extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Finishes
 - a. Unfinished spaces not exposed to view: rough bronze.
 - b. Finished spaces with ceiling: Concealed Sprinklers with flat round cover: white.
 - c. Provide escutcheons with matching color for finished spaces.

3.6 SYSTEM INSTALLATIONS

- A. Earthquake Protection: Provide piping according to NFPA 13 to protect from earthquake damage.
- B. Water supply control valves shall be electrically supervised and mechanically locked for proper position. Water flow and supervisory circuits shall be in accordance with the requirements of electrical specifications. Electric connections to sprinkler system shall be by Division 26. Furnish wiring diagrams for all equipment.
- C. Fire Department Connection: A system fire department connection shall be provided on the system riser in accordance with N.F.P.A. 13. Fire department connection shall be installed in an area accessible for the first response unit. Coordinate location and connection type with local fire department.
- D. A sprinkler head wrench of each style and model installed shall be provided to the owner at the completion of the project. A representative sampling of each sprinkler head style and model shall be provided to the owner and housed in a sprinkler head cabinet at or near the sprinkler riser. The number of sprinkler heads provided to the owner shall be in accordance with NFPA 13.
- E. Provide "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13
- F. Provide a vent near a high point in the system to allow air to be removed from that portion of the system.

SPRINKLER INSTALLATION

- G. Provide sprinklers in suspended ceiling in **center of all ceiling tiles**.
- H. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space per NFPA 13.
- I. Provide sprinkler piping with drains for complete system drainage.
- J. Hangers and Supports: Comply with NFPA 13 for hanger materials.

3.7 LABELING AND IDENTIFICATION

- A. Provide labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.8 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- C. Verify that specified tests of piping are complete.
- D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- F. Verify that potable-water supplies have correct types of backflow preventers.
- G. Verify that fire department connections have same type compatible with local fire department equipment.
- H. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- I. Fill wet-pipe sprinkler piping with water.
- J. Energize circuits to electrical equipment and devices.
- K. Coordinate with fire alarm tests. Operate as required.

3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.
- C. Clean and disinfect fire-suppression water-service piping as follows:
 - 1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651.
 - 4. Prepare reports.

3.10 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.11 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

END OF SECTION 210000

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230500, common work results for plumbing are included in this section.

END OF SECTION 220500

SECTION 220519 – THERMOMETERS AND PRESSURE GAUGES FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230519 for thermometer and pressure gauges for plumbing.

END OF SECTION 220519

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230529 for hangers and supports for plumbing piping and equipment.

END OF SECTION 220529

SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230553 for identification for plumbing piping and equipment.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230700 for plumbing insulation.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Work Results for Plumbing"
 - 2. Division 22 Section "Hangers and Supports"
 - 3. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.

1.2 SUMMARY

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- B. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- C. General layout shown, provide piping to fixtures as required by the *Maine Plumbing Code*. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Water penetration systems.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with the local building and plumbing codes.
- C. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.
- D. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," and NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for combined fire-protection and domestic water service piping to building.
- E. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- F. Water line components shall be lead-free.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. 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.
- C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 DUCTILE-IRON PIPING

- A. From inside face of exterior wall to a distance of approximately 5 feet outside of building (coordinate with Division 2). Provide flanged and anchored connection to interior piping. Materials shall be approved by the local water utility.
- B. Ductile iron pipe shall meet requirements of AWWA Standard C-151 (latest revision) and be cement lined and seal coated to meet AWWA Standard C-104 (latest revision). Joints shall meet requirements of AWWA C-111 (latest revision). Interior seal coated, bituminous paint oil cut, emulsion not acceptable, thickness minimum of 2 mils dry film thickness. Exterior bituminous coated with minimum of 2 mils dry film thickness. Class 52 wall thickness, 4-inch diameter through 12-inch diameter inclusive. Mechanical joint pipe to be furnished with gland, gaskets and Cor-Ten bolts and nuts.

- C. Ductile Iron Fittings Including Bends, Reducers, Off-Sets, Tees And Sleeves: Material shall be ASTM A536 latest, grade 70-50-05, in accordance with AWWA C153 (latest revision). Fittings shall be cement lined AWWA C104 (latest revision) or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116. Interior seal coated AWWA C104 with minimum of 4 mils dry film thickness. Exterior bituminous coated, 4 mils minimum dry film thickness or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116. Mechanical joint with accessories furnished: D.I. glands, gaskets, Cor-Ten T-bolts and nuts. Pressure Rating: Class 350 pressure rating in accordance with AWWA C153.

2.3 COPPER TUBING

- A. Hard Copper Tube: ASTM B 88, Types 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 end. 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.
 4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 5. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- B. Mechanically formed copper or steel tee connections are not acceptable.
- C. Viega Pro Press Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.4 PEX DOMESTIC WATER PIPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. PEX-a manufacturer system warranty shall cover tubing for a duration of 30 years from the date of installation.
1. Uponor Wirsbo hePEX (Basis of Design)
 2. Rehau
 3. Watts
 4. Viega

B. Code approved:

1. International Code Conference (ICC) – International Plumbing Code (IPC)
2. Uniform Plumbing Code (UPC)
3. Comply with ANSI/NSF Standard 14.
4. Comply with ANSI/NSF Standard 61
5. Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84.

C. Tubing

1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method
2. Type: Wirsbo AQUAPEX
3. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency
4. Standard grade hydrostatic design and pressure ratings from PPI
5. Fire-rated assembly listings in accordance with ANSI/UL 263.
6. Minimum Bend Radius (cold bending): No less than six times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
7. Nominal inside diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876 as indicated.

D. Fittings

1. Material: Fitting assembly is manufactured from material listed in paragraph 5.1 of ASTM F1960.
2. Material Standard: Comply with ASTM F1960.
3. Type: PEX-a cold expansion fitting. Assembly consists of the appropriate ProPEX insert with a corresponding ProPEX Ring.

E. Manifolds

1. Material
 - a. Type L copper body with UNS 3600 series brass ProPEX outlet connections
 - b. Engineered Plastic (EP) body with ProPEX outlet connections
2. Manifold Type
 - a. Uponor ProPEX Copper Manifold
 - b. Uponor engineered plastic (EP) Manifold
3. All manifolds manufactured with the appropriate-sized ProPEX fittings on the manifold supply inlets.

F. Accessories

1. Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer.

2. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
3. ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer.
4. The tubing manufacturer provides clips and/or PEX rails for supporting tubing runs.
5. All horizontal tubing hangers and riser clamps are epoxy-coated material.

2.5 VALVES

A. Ball Valves

1. The valve body and adapter shall be constructed using Lead Free brass. Lead Free ball valves shall comply with state codes and standards, where applicable, requiring reduced lead content.
2. ½" to 2" ball valves: 2-piece full port lead-free brass ball valves: The valve must have a blowout proof pressure retaining 316 stainless steel stem, 316 stainless steel ball, virgin PTFE seats, seals, stem packing seal and thrust washer. Valve must have adjustable packing. Valves with O-ring stem seal only are not acceptable. Pressure rating no less than 600psi WOG non-shock, 150psi WSP. Valve shall be manufactured to the MSS-SP-110 standard and shall be a Watts Series LFB6080 (threaded) or LFB6081 (solder).
3. Valve sizes 2-1/2" to 4" threaded, shall be rated to 400psi WOG non-shock and 125psi WSP. Valve sizes 2-1/2" to 3" solder shall be rated to 400psi WOG non-shock and 125psi WSP. Valve shall be a Watts Series LFFBV-3C (threaded) or LFFBVS-3C (solder).
4. Provide locking handle where indicated.
5. Comply with MSS SP-110.

B. Swing check valves:

1. Construct pressure containing parts of Valves as follows: Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62; Iron Body Valves: ANSI/ASTM A-126, Grade B.
2. Check valves shall be lead free.
3. Comply with the following standards for design, workmanship, material and testing: Bronze Valves: MSS SP – 80; Cast Iron Valves: MSS SP – 71
4. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
5. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc.
6. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc.

C. Refer to Division 22 Section "Plumbing Specialties" for balancing and drain valves.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.

3. Hyspan Precision Products, Inc.
 4. Mercer Rubber Co.
 5. Metraflex, Inc.
 6. Universal Metal Hose; a Hyspan company
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing. Working-Pressure Rating: Minimum 200 psig. End connections compatible with piping.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing. Working-Pressure Rating: Minimum 200 psig. End connections compatible with piping.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Pressure Rating: Provide components having a pressure rating equal to or greater than the system operating pressure.
- B. Mechanically formed tee-branch outlets and brazed joints shall not be used.
- C. Underground Domestic Water Service Piping: Use any of the following piping materials for each size range:
1. NPS 2 and Smaller: PE pipe; insert fittings for PE pipe; and banded or crimp-ring joints.
- D. Aboveground Domestic Water or Non-Potable Water Piping: Use the following piping materials for each size range:
1. NPS 2 and Smaller: Type L copper, PEX allowed for run outs.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use bronze ball valves for piping NPS 3 and smaller. Use cast-iron butterfly valves with flanged or grooved ends for piping NPS 4 and larger. Aquatherm: ball valves.
 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 3 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 4 and larger.

3. Hot-Water-Piping, Balancing Duty.
4. Drain Duty: Hose-end drain valves.

3.4 VALVE INSTALLATION

- A. Provide sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment.
- B. Provide shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops.
- C. Provide hose end drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

3.5 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.
- B. Provide underground ductile-iron piping according to AWWA C600 and NFPA 24.
- C. Provide shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service.
- D. Provide dielectric fittings as specified in Section 230500.
- E. Provide water-pressure regulators downstream from shutoff valves. Refer to Division 22 Section "Plumbing Specialties" for water-pressure regulators. Set outlet pressure at 80 psig maximum.
- F. Provide aboveground domestic water piping level and plumb, free of sags, kinks, and bends.
- G. Provide firestopping as per Section 230500 "Common Work Results for HVAC".
- H. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- I. Perform the following steps before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- J. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

- K. Check plumbing specialties and verify proper settings, adjustments, and operation.
- L. Energize circulators and verify proper operation.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 22 Section “Common Work Results for Plumbing” for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. Joints shall be fabricated, joined, and tested per manufacturer’s instructions.

3.7 PEX PIPING INSTALLATION

- A. Provide PEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
- B. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
- C. Protect PEX tubing with sleeves where abrasion may occur. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
- D. Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.
- E. PEX-a Piping Hanger Spacing: Provide hangers for PEX-a piping with the following maximum spacing:
 - 1. 1 inch and below: Maximum span, 32 inches.
 - 2. 1¼ inch and above: Maximum span, 48 inches.
 - 3. PEX-a Piping Hanger Spacing with PEX-a Support Channel: Provide hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer’s recommendations, with the following maximum spacing: Maximum span, 8 feet.
- F. PEX-a Riser Supports: Provide CTS riser clamps at the base of each floor and at the top of every other floor. Provide mid-story guides between each floor.
- G. Pipe Joint Construction: PEX-a Connections: Provide per manufacturer’s recommendations. Use manufacturer-recommended cold-expansion tool for F1960 connections.
- H. Pressurize PEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi above normal working pressure of the system. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32°F.

3.8 FLEXIBLE CONNECTOR INSTALLATION

- A. Provide flexible connectors in suction and discharge piping connections to each domestic water pump. Domestic water temperature maintenance pumps do not require flexible connectors.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Hanger, support, and anchor devices are specified in Division 22 Section "Hangers and Supports."

3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide piping adjacent to equipment and machines to allow service and maintenance.
- C. Use transition fitting to join dissimilar piping materials.
- D. Connect water piping in sizes indicated, but not smaller than sizes of unit connections.
- E. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.11 FIELD QUALITY CONTROL

- A. Follow local code requirements.
- B. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Test domestic water piping 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 domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.12 CLEANING

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses. Clean and disinfect domestic water piping per code requirements or administrative authority requirements. Sample procedure as indicated:

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: 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. 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.

B. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 221116

SECTION 221119 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following: Division 22 Sections.

1.2 SUMMARY

- A. This Section includes plumbing specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Piping: 125 psig.
 - 2. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 3. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data
- B. Field test reports.

1.6 QUALITY ASSURANCE

- A. Plumbing 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 a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with the local building and plumbing codes.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. Water line components shall be lead-free.
- F. NSF Compliance: Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-PW" on plastic potable-water piping and "NSF-DWV" on plastic drain, waste, and vent piping. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 ACCESS PANELS

- A. Provide access panels to concealed valves, cleanouts, and components that require service access. All components shall have proper access in accordance with manufactures' recommendations. Refer to Section 220500.

2.2 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Ames Co., Inc.
 - 2. Cla-Val Co.
 - 3. Apollo
 - 4. CMB Industries, Inc.; Febco Backflow Preventers.
 - 5. Conbraco Industries, Inc.
 - 6. Watts Industries, Inc.; Water Products Div.
 - 7. Zurn Industries, Inc.; Wilkins Div.
- B. General: ASSE standard, backflow preventers.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - 3. Interior Components: Corrosion-resistant materials. AWWA C550 or FDA-approved
 - 4. Exterior Finish: manufacturer's standard.
 - 5. Strainer: On inlet, lead-free.
 - 6. Lead free.
 - 7. Backflow preventers for hot water over 110F shall be a listed type for that application.
- C. Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.

D. Testable Double-Check Backflow Prevention Assemblies:

1. Equal to: Watts Series LF007 (2-1/2" and smaller) with strainer assembly.
2. Equal to: Watts Series LF709 (3" and larger) with strainer assembly.
3. ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
4. Lead-free

2.3 UTILITY WATER METERS

- A. Portland Water District provides and installs the water meter.
- B. Remote Registration System: Complying with AWWA; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

2.4 WATER PRESSURE REGULATORS

- A. Manufacturers:
 1. Zurn Industries, Inc.; Wilkins Div.
 2. Cashco, Inc.
 3. Cla-Val Co.
 4. Conbraco Industries, Inc.
 5. FLOMATIC Corp.
 6. Honeywell Braukmann.
 7. IMI Cash Valve.
 8. Watts Industries, Inc.; Water Products Div.
- B. The water pressure reducing valve shall be Lead Free, certified to NSF/ANSI 372 and ASSE Listed 1003, with an integral strainer, direct acting integral by-pass and balance piston actuator. The main body shall be low lead cast bronze (ASTM B 584) alloy. The bell shall be composite plastic. The cartridge shall be NSF Listed acetal and incorporate an integral seat. The seat disc elastomer shall be NSF Listed EPDM. The assembly shall be accessible for maintenance without removing the device from the line. The water pressure reducing valve shall be a Zurn Wilkins Model NR3XL or equal.

2.5 BALANCING VALVES

- A. DHW Recirculation Balancing Valves
 1. Furnish and install as indicated on the plans, Circuit Solver in the domestic hot water piping. Circuit Solver shall be self-contained and fully automatic without additional piping or control mechanisms. Valve shall be Circuit Solver as manufactured by ThermOmegaTech or equivalent.

2. Circuit Solver shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.
3. When fully closed valve shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.
4. Valve shall be factory adjustable from 105°F to 140°F as required by project conditions. Valve shall modulate between open and closed position within a 10°F range.
5. Valve body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
6. Valve shall be rated to 200 PSIG maximum working pressure. Valve s shall be rated to 300°F maximum working temperature.
7. Valve s shall be standard tapered female pipe thread, NPT.
8. Circuit Solver shall be ANSI/AWWA C800 compliant. Circuit Solvers shall be NSF-61 certified with zero lead content for use in all domestic water systems.
9. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits. Thermal actuator shall be rated for a minimum of 200,000 cycles.

B. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.6 THERMOSTATIC WATER MIXING VALVE PACKAGE

A. Manufacturers:

- a. Armstrong International, Inc.
- b. Lawler Manufacturing Company, Inc.
- c. Leonard Valve Company.
- d. Powers; a division of Watts Water Technologies, Inc.
- e. Symmons Industries, Inc.

B. **TMV-1** Basis of Design: POWERS Hydroguard, Thermostatic Mixing Valve, model # LFLM490 (3/4").

1. Thermostatic water mixing valve, solid bimetal dial thermostat directly linked to valve porting to control the intake of hot and cold water and compensate for supply temperature or pressure fluctuations. The TMV shall be highly responsive and cannot be damaged by extremes in temperature. Sweat inlets and outlet, 0.5 GPM minimum flow capacity.

2. Integral combination checkstops, Internal parts of lead free bronze, lead free brass, and stainless steel, Integral wall support, Color-coded dial, HOT-COLD with directional indicators, Maximum operating pressure 125 PSI, Adjustable high temperature limit stop set for 120° F, Locking temperature adjustment knob.
3. This product shall be certified to meet Low Lead requirements of wetted surface area containing less than 0.25% lead by weight

2.7 STRAINERS FOR DOMESTIC WATER PIPING

- A. 3" and smaller: Y-type strainer shall be domestically manufactured, and conform to MIL-S-16293, and be ANSI 3rd party certified to comply with states' lead plumbing law 0.25% maximum weighted average lead content requirement. The main body shall be low lead bronze (ASTM B 584), the access cover shall be yellow brass (ASTM B 16) or cast bronze (ASTM B 584), the strainer screen shall be 300 series stainless steel, 20 mesh. Screens shall be accessible for cleaning without removing the device from the line. The "Y" type strainer shall be a WILKINS Model YBXL. Drain: Pipe plug.
- B. 4" and larger: The lead-free cast iron "Y" type strainer shall be in compliance with MIL-S-16293F Type 2. The main body and access cover shall be cast iron (ASTM A 126 Class B) and coated with a FDA approved epoxy coating inside and out. The integral strainer screen shall be accessible for cleaning without removing the device from the line. The Cast Iron "Y" type strainer shall be a WILKINS Model FSC-DOM. Pressure/temperature: 200 psi @ 150°F WOG; End connections: Flanged Class 125 lb. Drain: Factory-installed, hose-end drain valve.

2.8 HYDRANTS AND HOSE BIBBS

- A. Manufacturers:
 1. Josam Co.
 2. Murdock, Inc.
 3. Simmons Manufacturing Co.
 4. Smith, Jay R. Mfg. Co.
 5. Tyler Pipe; Wade Div.
 6. Watts Industries, Inc.; Drainage Products Div.
 7. Woodford Manufacturing Co.
 8. Zurn
 9. MAPA Products
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
 1. Inlet: NPS 3/4 or NPS 1 threaded or solder joint.
 2. Outlet: ASME B1.20.7, garden-hose threads.
 3. Operating Keys: One with each key-operation hydrant.

- C. Non-freeze Exposed-Outlet Wall Hydrants: Zurn Z1321, ASSE 1019, ¾" pipe connection; self-drainable with integral non-removable hose-connection backflow preventer, casing and operating rod to match wall thickness, projecting outlet, and wall clamp.
- D. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS ½ threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig; integral non-removable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
 - 1. Equipment Rooms: Rough bronze, wheel handle,
 - 2. Finished Rooms: Chrome plated, operating key
 - 3. Include integral wall flange with each chrome plated hose bibb.

2.9 WATER HAMMER ARRESTORS

- A. Manufacturers:
 - 1. Zurn
 - 2. Precision Plumbing Products, Inc.
 - 3. Sioux Chief Manufacturing Company, Inc.
- B. Lead-free 0.25% maximum weighted average lead content requirement, consist of a copper body with a low lead brass hexagonal male pipe threaded inlet, an acetal, polycarbonate or low lead brass piston with Buna Nitrile or EPDM O-rings and lead free solder; ASSE® Listed 1010, ANSI A112.26.1. The device shall be pre-charged and sealed at the factory. The Water Hammer Arrester shall be a WILKINS Model 1250XL.

2.10 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 - 1. Description: Pipe fittings assembled to make a trapped receptacle similar to a floor drain but usually without a grate. They are installed with the top above the floor level, so they are not a substitute for a floor drain.
 - 2. 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.
 - 3. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Expansion Joints: telescoping pipe fittings that permit the contraction or expansion movement of vertical stacks. Standard: ASME A112.21.2M. Body: Cast iron with bronze sleeve, packing, and gland.
- 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. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
3. Small AC condensate drain into sink trap: Airgap International, Inc. Drain Boa, Eco-Tech, or equal; Inlet port directly accepts 3/8" poly tubing. Dual plumbing code listed sink tailpiece fitting. Listed by NSF® and UPC®.
4. Fixed Air-Gap Fittings: Zurn Z1024/Z1025 or Precision Plumbing Products; manufactured cast-iron or bronze drainage fitting with semi-open top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: match piping.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 CLEANOUTS

A. Manufacturers

1. Zurn
2. Smith, Jay R. Mfg. Co.
3. Josam Co.
4. Tyler Pipe, Wade Div.
5. Watts Industries, Inc., Drainage Products Div.
6. Mifab
7. Wade

B. Cleanouts shall be easily accessible and shall be gastight and watertight. Provide a minimum clearance of 24 inches for the rodding. Size of cleanout shall be same as pipe size through 4". Pipes 4" and larger shall have 4" cleanouts.

C. Floor Cleanouts: Mifab C1000 Series floor cleanout with heavy-duty nickel-bronze or stainless steel adjustable top.

1. Compliance: ANSI/ASME A112.36.2M.
2. Load Rating: Up to 7,499 pounds.

3. Body: A1, 8-inch diameter body. Lacquered, ASTM A 48, Class 25 cast iron body with anchor flange. O-ring secondary gasket seal. 4-inch; 4" NPS machined integral body threads.
 4. Combined Access Cover and Plug Top Assembly: Heavy-duty, round, 5-inch diameter; square, 5-inch by 5-inch (for tile insertion), adjustable, Type 304 stainless steel top assembly with No. 4 satin finish. Neoprene primary gasket seal. Vandal-resistant stainless steel screws.
 5. When a waterproof membrane is used in the floor system, provide clamping collars on the cleanouts.
 6. In carpeted areas, provide carpet cleanout markers.
- D. Cleanouts shall consist of "Y" fittings and (1/8 inch) bends with brass or bronze screw plugs.
- E. Provide cleanouts at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. Cleanout shall consist of sanitary tees. . Extend the cleanouts to the wall access cover; Mifab 1400 Series.
- F. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.13 FLOOR DRAINS

- A. Manufacturers
1. Zurn Industries, Inc
 2. Jay R. Smith Mfg. Co.
 3. Tyler Pipe, Wade Div.
 4. Watts Industries, Inc
 5. Mifab
 6. Wade
- B. Floor drains shall comply with ASME A112.21.1M. Provide outlet type as required by piping system used.
- C. Provide 1/2" trap primer connection as indicated on plans. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Light Duty FD-1: bathroom and finished areas; ZURN ZN415BZ-P, Dura-Coated cast iron body with 2" bottom outlet, combination invertible membrane clamp and adjustable collar with seepage slots, and "TYPE BZ" polished nickel bronze light-duty leveling strainer.
1. Provide vandal secured top.
- E. Heavy Duty FD-2: mechanical rooms; ZURN Z525-P 9" diameter top drain, Dura-Coated cast iron body with 3" bottom outlet, seepage pan and adjustable extension frame with medium-duty cast iron deep slotted grate.

2.14 TRAP SEAL PRIMER VALVES

1. Manufacturers:
 - a. Precision Plumbing Products, Inc.
 - b. Josam Co.
 - c. Watts.
 - d. Zurn
 - e. Mifab
 - f. Sioux Chief

B. Trap primer make up lines must have a continuous slope to the floor drain.

C. Electronic Trap Primer – TP-1

1. Precision Plumbing Products Model MP-500
2. Operation: A preset timer energizes a normally closed electronic solenoid valve. Potable water flows across the air gap and is distributed via trap primer feed lines. The timer then de-energizes the solenoid allowing it to close until the next operational cycle.
3. Cabinet: Surface-mounted steel box; NEMA Type 1, UL 50, 12" x 12" x 4" - 16 gauge steel w/screw on cover ANSI 61 gray polyester powder paint.
4. Electric Controls: Pre-set timer opens once for 6 seconds every 24hours. 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. 120/1/60, 0.23 Amps. Circuit Breaker, Test Switch, Timer, Solenoid Valve UL Listed. Electrical assembly listed per UL # 73.
5. Air gap fitting
6. Solenoid valve with integral strainer screen
7. Piping: ASTM B 88, Type L copper water tubing. 95-5 lead-free. Containing lead not in the excess of 0.2%; Inlet: ½" NPT male; Outlet: ½" NPT female.
8. Provide a distribution unit for multiple outlet installations.
9. Standard: ASSE 1044.

2.15 ROOF DRAINS

A. Roof Drains: Comply with ASME A112.21.2M.

B. Manufacturers

1. MIFAB
2. Josam Co.
3. Froet Industries
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe, Wade Div.
6. Watts
7. Zurn

- C. Overflow Roof Drains (**RD-1**): ZURN Z103-45, bi-functional roof drains, or equal.
1. Dual Outlets:
 - a. Primary Drain Outlet: Attached to storm piping
 - b. Overflow Drain Outlet: Attached to relieve area outside of building, separate from primary drain system.
 - c. Secondary drain downspout daylighted nozzle: FROET LPS nozzle design diverts water away from building, eliminating wall stains. Wall flange covers rough opening and serves as anchor. Hinged perforated flapper cover. Architect to select color from factory standard color chart.
 2. Compliance: ANSI/ASME A112.6.4; IAPMO IGC 187; ICC-ES LC 1021.
 3. Body: Bi-functional; Cast Iron: ASTM A 48, Class 25; Anchor flange; Powder coated.
 4. Dome Strainer: Cast Iron: ASTM A 48, Class 25; Minimum Free Area: 136 square inches.
 5. Waterproofing Membrane Clamp Ring: Width: 2.375 inches; Cast Iron: ASTM A 48, Class 25.
 6. Integral Gravel Stop: 1-1/4-inch height minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Provide backflow preventers in each water supply to hydronic 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. Provide 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. Access shall be provided for testing, maintenance and repair. Locate backflow preventer between 2 feet and 5 feet above floor.
 5. Test of Backflow Prevention Assemblies: Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14).
- C. Provide pressure regulators with inlet strainer and shutoff valve, outlet shutoff valve and balance valve bypass. Provide pressure gages on inlet and outlet. Set field-adjustable pressure set points of water pressure-reducing valves.

- D. Trap primers:
1. Provide floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection. Primers shall be accessible for maintenance.
 2. Provide trap seal primers in accordance with manufacturer's instructions.
 3. Cycle trap seal primers a minimum of 6 times to ensure optimum performance.
 4. Ensure flux and other debris is removed.
 5. Do not install trap seal primers closer than 40 feet apart when using same potable water supply line.
 6. Mount trap seal primers in a vertical position 1 foot above finished floor for every 20 feet of floor drain trap make-up water line.
 7. Provide union connection above trap seal primers.
 8. Provide line shut-off valve upstream of trap seal primers to shut off water supply when performing maintenance on trap seal primers.
 9. Avoid direct installation to prevent foreign material from entering directly into trap seal primers.
- E. Provide expansion joints on vertical risers, stacks, and conductors as required by code.
- F. Cleanouts:
1. Provide cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated: Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated. Locate at each change in direction of piping greater than 45 degrees. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping. Locate at base of each vertical soil and waste stack.
 2. Provide cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
 3. Provide cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
 4. Provide flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- G. Provide floor drains in accordance with manufacturer's instructions at locations indicated on the drawings.
1. Protect installed floor drains from damage during construction.
 2. Provide floor drains at low points of surface areas to be drained. Floors shall be sloped to floor drains.
 3. Provide floor drains plumb, level, and to correct elevation.
 4. Ensure top of floor drains are flush with top of finished floor.
 5. Provide floor drains using manufacturer's supplied hardware.
 6. Coordinate depressed/pitched slab with concrete contractor.
 7. Provide floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 8. Provide individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

H. Roof Drains:

1. Coordination: Roof drains installed and flashed by roofing contractor. Roof drains furnished, insulated, and connected to piping by Division 22.
2. Examine areas to receive roof drains. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.
3. Provide roof drains in accordance with manufacturer's instructions at locations indicated on the drawings.
4. Provide roof drains plumb, level, and to correct elevation.
5. Provide roof drains using manufacturer's supplied hardware.
6. Protect installed roof drains from damage during construction.
7. Daylight roof drain overflow piping with nozzle at locations shown on drawings.

I. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated. Fasten recessed-type plumbing specialties to reinforcement built into walls. Provide wood-blocking reinforcement for wall mounting and recessed-type plumbing specialties.

J. Provide individual shutoff valve in each water supply to plumbing specialties. Provide shutoff valves in accessible locations.

K. Provide air vents at piping high points. Include ball valve in inlet.

L. Provide traps on plumbing specialty drain outlets.

M. Water hammer arrestors shall be installed at, solenoid valves and flush valve water closets, as shown on the plans and as recommended by Plumbing & Drainage Institute Standard PDI-WH-201. Locate units at the end of branch lines, between the last two fixtures served. Size units based on fixture unit total of branch. All branch pipes serving flush valve water closets shall have water hammer arrestors.

N. Provide 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.

O. Circuit Solver DHW Recirculation Balancing Valve: (Optional to manual circuit setter valves)

1. Provide Circuit Solver in each domestic hot water return piping branch beyond last hot water device in that branch.
2. Provide suitable line size isolation valves, unions, and strainer.
3. Provide suitable access panel as required in non-accessible ceilings and walls.

3.2 ROUGHING-IN FOR UTILITY WATER METERS

A. Provide water meter horn connections, piping, and specialties according to AWWA M6 and utility's requirements. Portland Water District installs the meters.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 22 Sections.
- D. Connect plumbing specialties and devices that require power according to Electrical Specification Sections.

3.4 FIELD QUALITY CONTROL

- A. Test each vacuum breaker backflow preventer trap primer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221316 – PLUMBING SANITARY AND STORM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Work Results for Plumbing"
 - 2. Division 22 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.

1.2 SUMMARY

- A. This Section includes soil and waste, sanitary drainage and vent piping inside the building and to locations indicated.
- B. This Section includes storm-drainage piping inside the building and to locations indicated.
- C. This Section includes radon vent piping.
- D. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- E. General layout shown, provide piping to fixtures as required by the Maine Plumbing Code. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

1.3 PERFORMANCE REQUIREMENTS

- A. Comply with the utility requirements for the connection of to the municipal utility services. Obtain and pay for all necessary permits from the applicable municipal department. Obtain authority to connect to their existing mains.
- B. Provide components and installation capable of producing piping systems with working-pressure ratings per local plumbing code.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with the local building and plumbing codes.
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 CAST-IRON SOIL PIPING

- A. Hubless
 - 1. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
 - 2. Hubless couplings shall conform to ASTM C-1540 heavy duty couplings.
 - 3. Gaskets shall conform to ASTM C-564. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and local code requirements.
 - 4. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque. Tighten bands with a properly calibrated torque limiting device.
- B. Hub and Spigot Cast Iron Soil Pipe and Fittings:
 - 1. Hub and Spigot Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. Pipe and fittings to be Extra Heavy (XH).
 - 2. Joints can be made using a compression gasket manufactured from a neoprene elastomer meeting the requirements of ASTM C-564 or lead and oakum. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with

manufacturer's recommendations and local code requirements. The system shall be hydrostatically tested after installation to 10 ft. of head (4.3 psi maximum).

2.3 PVC DRAINAGE PIPING

- A. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D-1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D-1785 and ASTM D-2665. Fittings shall conform to ASTM D-2665.
- B. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D-2564, primer shall conform to ASTM F-656. The system to be manufactured by Charlotte Pipe and Foundry Co. or approved equal; and shall be intended for non-pressure drainage applications where the temperature will not exceed 140°F.
- C. Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil and other foreign material, apply primer in accordance with ASTM F656.

2.4 ABS PIPING

- A. ABS Pipe: ASTM D 2661, Schedule 40, solid wall. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Aboveground and Underground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:
 - 1. PVC or Cast iron
 - a. Under slab
 - b. Concealed
 - c. Vents

- C. Vent Piping through roof/exposed above roof: Use any of the following piping materials for each size range:
 - 1. ABS
- D. Elevator sump pump discharge piping: Type L sweated copper.
- E. Radon Vent Piping: PVC. Pitch horizontal runs 1/8" per foot to allow accumulated condensation to drain. Terminate pipe at least 30 feet from outside air intakes. Label outlet "Soil Gas Vent Stack".
- F. Storm Drain Piping:
 - 1. Cast iron
 - 2. Schedule 40 PVC DWV
 - 3. Storm Drain Piping, heat traced: Cast iron

3.3 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.
- B. Provide firestopping as per Section 230500 "Common Work Results for HVAC".
- C. 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."
- D. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- E. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- F. Make changes in direction for 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.
- G. Provide 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.
- H. Install drainage and vent piping at the minimum slopes as required by the local plumbing code.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

- J. Install cleanouts at grade and extend to where building drains connect to site piping. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings." Gasketed Joints: Make with rubber gasket matching class of pipe and fittings. Hubless Joints: Make with rubber gasket and sleeve or clamp.

3.5 VALVE INSTALLATION

- A. Shutoff Valves: Install full-port ball valve on each pump discharge.
- B. Check Valves: Install swing check valve, downstream from shutoff valve, on each pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Hanger, support, and anchor devices are specified in Division 22 Section "Hangers and Supports."
- B. All under slab piping (rainwater, radon, sanitary, and vent) shall be installed with stainless pipe hangers and rods.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior drainage piping to exterior drainage piping.
- C. Use transition fitting to join dissimilar piping materials.
- D. Connect drainage and vent piping to fixtures and equipment as shown on the plans.
- E. Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

3.8 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. Test 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 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. 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.
- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. 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.
- D. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- E. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

3.9 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 221316

SECTION 221429 – ELEVATOR SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following: Division 22 Section "Common Work Results for Plumbing"

1.2 SUMMARY

- A. This Section includes sump pumps for elevator sump pits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered.
- 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

- C. Comply with pump manufacturer's rigging instructions for handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Weil Pump Co.
 - 2. Little Giant Pump Co.
 - 3. Weil Pump Co.
 - 4. Zoeller Pump Co.
 - 5. Liberty Pumps.
 - 6. Myers
 - 7. Stancor
 - 8. Bell & Gossett

2.2 ELEVATOR SUMP PUMP

- A. The OilTector control system shall be designed and approved for the safe operation of pumping, alarming and monitoring of elevator sump pits. The OilTector shall activate a pump to remove water from elevator pits in accordance with ASME A17.1.
- B. Components required for the repair of the pump shall be shipped within a period of 24 hours.
- C. The castings shall be constructed of Class 25 cast iron. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat from the motor. All mating parts shall be machined and sealed with a Buna-N O-ring. All fasteners exposed to the liquid shall be stainless steel. The motor shall be protected on the top side with sealed cord entry plate with molded pins to conduct electricity eliminating the ability of water to enter internally through the cord. The motor shall be protected on the lower side with a unitized ceramic/carbon seal with stainless steel housings and spring or engineered double lip seal with stainless steel springs. The pump shall be furnished with stainless steel handle. The exterior of the casting shall be protected with powder coat paint. The pump shall have cast iron support legs, enabling it to be a free standing unit.
- D. The submersible pump shall be supplied with a 25 feet of multiconductor power cord. It shall be cord type YELLOW UL 16-3 SJEOOW 300V 105°C, capable of continued exposure to the pumped liquid. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. The power cable shall not enter the motor housing directly but will conduct electricity to the motor by means of a water tight compression fitting cord plate assembly, with molded pins to conduct electricity. This will eliminate the ability of water to enter internally through the cord, by means of a damaged or wicking cord.
- E. Single phase motors shall be oil filled, permanent split capacitor, Class B insulated NEMA B design, rated for continuous duty. At maximum load the winding temperature shall not exceed

130 degrees C unsubmerged. Since air filled motors are not capable of dissipating heat they shall not be considered equal. The pump motor shall have an integral thermal overload switch in the windings for protecting the motor. The capacitor circuit shall be mounted internally in the pump.

- F. An upper sleeve and lower ball bearing shall be required. The lower ball bearing shall be a single ball / race type bearing. Both bearings shall be permanently lubricated by the oil, which fills the motor housing. The motor shaft shall be made of 300 or 400 series stainless steel.
- G. The pump shall have a unitized carbon / ceramic seal with stainless steel housings and spring, or engineered double lip seal with stainless steel springs. The motor plate / housing interface shall be sealed with a Buna-N O-ring. The impeller shall be vortex style made of an engineered polymer, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be threaded to the motor shaft.
- H. The pump shall have a ground continuity check and the motor chamber shall be Hi-potted to test for electrical integrity, moisture content and insulation defects. The motor and volute housing shall be pressurized, and an air leak decay test is performed to ensure integrity of the motor housing. The pump shall be run, voltage current monitored, and the tester checks for noise or other malfunction.
- I. Controls:
 - 1. The OilTector shall stop the pump before oil or other harmful substances enter our water supply. Indicator lights will illuminate on the control panel for the following: power, pump running, high water, and high oil. The panel has a set of auxiliary contacts that activate on power loss or high Oil/Water conditions. These contacts can be connected to the OilTector remote panel which contains audio/visual alarming along with auxiliary contacts for connection to Building Automation System.
 - 2. The control unit has three probes and a float ball switch. The pump will activate when the middle probe contacts water, and will remain on until the first, longest probe no longer is in contact with water. A high water alarm is activated when third or shortest probe contacts water. The system will ignore a small film of oil, however larger volumes of oil will be detected when the alarm probe does not detect water and the float ball activates. The system will continue to operate, removing water not oil from the vault even when oil has been detected.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections before pump installation.

3.2 CONCRETE

- A. Install concrete bases of dimensions indicated for sump pumps. Refer to Division 22 Section "Common Work Results for Plumbing."

- B. Concrete for pits and sumps is specified in Division 3. Coordinate pit size with Division 3. The minimum sump size shall be 20" x 20" x 30" deep.

3.3 INSTALLATION

- A. Install pumps according to manufacturer's written instructions.
- B. Install pumps and arrange to provide access for maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support piping so weight of piping is not supported by pumps.
- D. Coordinate location of GFI 3-prong grounded electrical receptacles, extension cords are not permitted.
- E. Pit must be cleaned of debris after installation.

3.4 CONNECTIONS

- A. Install swing check valve on each pump discharge.
- B. Install electrical connections for power, controls, and devices. Connect pump, level switch, and alarm panel to GFCI outlets.

3.5 STARTUP SERVICE

- A. Perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, natural gas-fired, high-efficiency, storage, domestic-water heater and hydronic heating combined appliance.
 - 2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, venting method, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: 7 years. (12 years limited).
 - 2) DHW to hydronic plate and frame heat exchanger: One year.
 - 3) Controls and Other Components: One year.
 - b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, NATURAL GAS-FIRED, STORAGE, DOMESTIC-WATER HEATER COMBINED APPLIANCE

- A. Manufacturers:
 - 1. HTP Mfg. (Basis of Design)
 - 2. American Water Heaters
 - 3. Rheem
- B. Commercial, Natural Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters & Hydronic Heating Combined Appliance:
 - 1. Standard: ANSI Z21.10.3/CSA 4.3.
 - 2. Description: Manufacturer's proprietary design to provide at least 94 percent combustion efficiency at optimum operating conditions.
 - 3. Storage-Tank Construction: 316L stainless steel 125 psi minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

- b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
4. Factory-Installed Storage-Tank Appurtenances:
 - a. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls. R14.2 walls and R21.3 top.
 - d. Jacket: Plastic jacket.
 - e. Burner: High grade Inconel, 90/10 Copper Nickel
 - f. Hydronic Heating Modul: Brazed plate
 - g. Controls: Factory control panel to allow set point control of DHW temperature as well as Hydronic Heating Module (HHM) control. HHM shall be set up to operate thru a hot water supply temperature reset curve based on outside air (OA) temperature. When OA is 30 F HWS is 150 F and when OA is 65 HWS is 120 F.
 - h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- C. Capacity and Characteristics:
1. Capacity: 55 gal.
 2. Recovery: 148 gph at 100 deg F temperature rise.
 3. Temperature Setting: 125 deg F.
 4. Fuel Gas Input: 130,000 Btu/h.
 5. Hydronic Heating Module Output: 100,000 Btu/h.
 6. Gas Pressure Regulator:
 - a. Gas Pressure Required at Burner: 4 – 14 inches water column.
 7. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phase: Single.
 - c. Hertz: 60.
 - d. Maximum Overcurrent Protection: 15 A.
 8. Minimum Vent Diameter: 2” intake and 3” exhaust thru concentric vent kit.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Air-Charging Valve: Factory installed.
3. Capacity and Characteristics:
 - a. Working-Pressure Rating: 100 psig.
 - b. Capacity Acceptable: 4 gal. minimum.

B. Heat-Trap Fittings: ASHRAE 90.2.

C. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

D. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.

E. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

F. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

G. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

2.3 SOURCE QUALITY CONTROL

- ### A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspection requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Anchor domestic-water heaters to substrate.
- B. Install gas-fired, domestic-water heaters according to NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 - 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."
- C. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

- G. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill domestic-water heaters with water.
- I. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 231123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspection requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports for DHW side and Hydronic Heating side of combination unit.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heater and combination hydronic heating.

END OF SECTION 223400

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Work Results for Plumbing"
 - 2. Section 221116 – "Domestic Water Piping".
 - 3. Division 22 Section "Plumbing Specialties"

1.2 SUMMARY

- A. This Section includes Plumbing Fixtures.

1.3 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. 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. Comply with the local building and plumbing codes.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Comply with UL 1951 - Standard for Electric Plumbing Accessories
- G. Water line components shall be lead-free.

1.5 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Common Plumbing Fixture Requirements
 - 1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixture color shall be white except as specified herein.
 - 2. Provide combinations of fixtures and trim, faucets, fittings, and other components that are compatible. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings.
 - 3. Coordinate fixture rough in dimensions for conflicts with surrounding structure, prior to submitting.
 - 4. Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap.
 - 5. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view.
 - 6. Fixture supports for off-the-floor fixtures shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.
 - 7. Provide access panels to concealed valves and components. All components shall have proper access in accordance with manufactures' recommendations. Refer to Section 220500.
 - 8. Mounting heights: Refer to Architectural Plans.

2.2 TANK TYPE WATER CLOSET

A. Manufacturers:

1. American Standard
2. Kohler
3. Toto
4. Gerber

B. Tank Type Toilets - Common Requirements:

1. Comply with ASME A112.19.2 – Ceramic Plumbing Fixtures
2. Comply with ADA
3. Toilet shall be EPA Water Sense Certified.
4. Material: Vitreous china, white.
5. Type: Siphon jet.
6. Rim Contour: Elongated.
7. MaP Rating: 1,000 grams minimum.
8. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
 - c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
 - d. Operation: Wheel handle.
 - e. Riser Size: NPS 3/8; Material: ASME A112.18.6, braided- or corrugated-stainless-steel flexible hose riser.
9. Provide wax ring, bolt caps, gaskets, and accessories for a complete code-compliant installation.
10. Toilet Seats:
 - a. Standard: IAPMO/ANSI Z124.5.
 - b. Material: Solid polypropylene.
 - c. Provide a permanent surface that inhibits the growth of stain and odor causing bacteria, mold and mildew on the surface
 - d. Type: Commercial (Heavy duty).
 - e. Shape: Elongated rim, open front.
 - f. Hinge: Check.
 - g. Seat Cover: None.
 - h. Color: White.

- C. **P-1**: American Standard Cadet Pro – “Right Height”, 16-1/2” ADA rim height, 1.28 GPF, 9” x 8” water area; 1,000g MaP Score; elongate bowl; EverClean surface included.



D.

2.3 LAVATORIES

A. Lavatory Manufacturers:

1. Zurn
2. American Standard
3. Kohler
4. Toto
5. Duravit

B. Faucet Manufacturers

1. Moen
2. Symmons
3. Delta Commercial
4. Chicago
5. Gerber
6. Zurn
7. Kohler
8. American Standard

C. Lavatories – Common Requirements:

1. Standard: ASME A112.19.2/CSA B45.1; ADA.
2. Faucet-Hole Punching: Match faucet, coordinate hole-locations.
3. Provide a permanent surface that inhibits the growth of stain and odor causing bacteria, mold and mildew on the surface
4. Provide overflow.
5. Provide 304 stainless steel grid drain unless noted otherwise.
6. Risers: Supply line: supplied by fixture manufacturer, or by McGuire or Brasscraft. Shall be lead-free, loose key standard stop lavatory supply kit, two polished chrome, solid brass angle stops with wheel handles, two 12" flexible chrome-plated lavatory risers, complete with two forged brass with set screw flanges; connections: 1/2" sweat x 3/8" OD.
7. Waste Fittings: Standard: ASME A112.18.2
8. Drain: Stainless steel grid type with NPS 1-1/4 offset and straight tailpiece.
9. Trap: NPS 1-1/2 by NPS 1-1/4; Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.

10. ADA Pipe covering kit equal to Dearborn Safety Series by Oatey; Cover opens 180° for easy installation, EVA foam material, sized for 1 ¼” and 1 ½” cast traps, IAPMOPS-94.

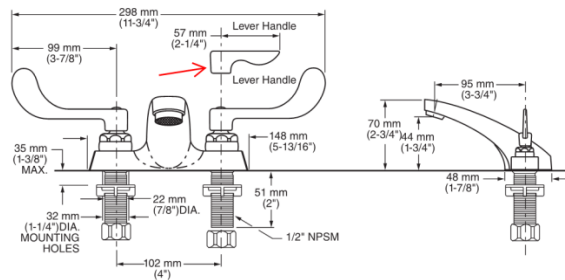
D. Faucets - Common Requirements:

1. Comply with ASME A112.18.1M, NSF372-2011, ADA; UL 1951
2. Body Material: Commercial, solid cast brass.
3. Lead Free: Faucet contains $\leq 0.25\%$ total lead content by weighted average

- E. **P-2** Wall Mounted china: Provide ASME A112.6.1M lavatory carrier. Lavatory mounting height: See architectural plans. American Standard “Lucerne”; Nominal Size: Rectangular, 20.5” x 18.25”.



- F. **P-2** Faucet: 4" centerset lavatory faucet shall be cast brass construction with shank nuts and brass coupling nuts. Shall feature water-conserving vandal-resistant 0.5 GPM pressure-compensating multi-laminar spray. Vandal-Resistant lever-handles. Shall also feature ¼-turn washer-less ceramic disc valve cartridges. Fitting shall be American Standard Model # 5502.145.002.



2.4 STAINLESS STEEL SINKS

A. Sink Manufacturers:

1. Elkay Manufacturing Co.
2. Just Manufacturing Co.
3. Moen
4. Kindred
5. Advance Tabco

B. Faucet Manufacturers

1. Moen
2. Symmons
3. Delta Commercial
4. Chicago
5. Gerber
6. Zurn
7. Kohler
8. American Standard

C. Sinks – Common Requirements:

1. Standard: ASME A112.19.2/CSA B45.1; ADA.
2. Faucet-Hole Punching: Match faucet, coordinate hole-locations.
3. Risers: Supply line: supplied by fixture manufacturer, or by McGuire or Brasscraft. Shall be lead-free, loose key standard stop lavatory supply kit, two polished chrome, solid brass angle stops with wheel handles, two 12" flexible chrome-plated lavatory risers complete with two forged brass with set screw flanges; connections: 1/2" sweat x 3/8" OD.
4. Waste Fittings: Standard: ASME A112.18.2
5. P-trap: heavy cast brass adjustable body, with slip nut, with cleanout, box flange and seamless tubular wall bend.
6. Grid drains, where indicated, shall be 304SS.
7. Pipe covering kit equal to Dearborn Safety Series by Oatey; Cover opens 180° for easy installation, EVA foam material, sized for 1 ¼" and 1 ½" cast traps, IAPMOPS-94.

D. Faucets - Common Requirements:

1. Comply with ASME A112.18.1M, NSF372-2011, ADA; UL 1951
2. Body Material: Commercial, solid cast brass.
3. Lead Free: Faucet contains ≤ 0.25% total lead content by weighted average
4. Top mounted self-rimming counter sink, 18-gauge; type 304 stainless steel.

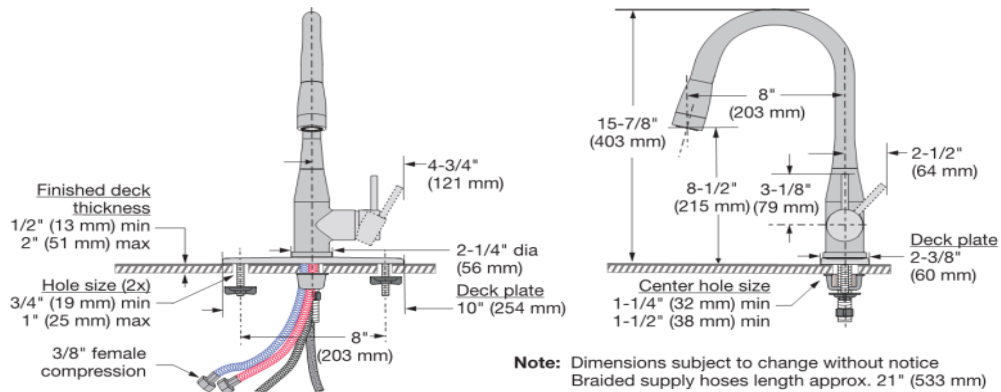
E. **P-3** Sink

1. Basis of Design: Elkay CR2521, 25" x 21-¼" x 6-7/8"
2. 304-SS grid drain.



F. **P-3** Faucet: Basis of design: Symmons S-2302-PD “Serenio” - Single handle kitchen faucet with pull-down hand spray spout and retractable hose; 2.2 GPM, braided hose water connections; stainless steel finish; ADA compliant, lead-free.

Dimensions Sereno Kitchen Faucet, S-2302-PD



2.5 MOP BASIN

A. **P-4:** Mop Service Basin: Zurn Z1996-24. Molded high density molded stone basin; 24 x 24 x 10"H; PVC drain body, stainless steel strainer, and 3" gasketed outlet connection. Certifications: Meets ANSI Z124.6, CSA listed, and IAPMO listed under file # 3561.

1. Wall Guard (-WG) Provide 20 gage type 304 stainless steel bumpers used to protect walls adjacent to mop basin. Two panels shall be supplied for corner installation
2. Bumper Guards (-BS) Provide 20 gage type 304 stainless steel bumper guards to protect top edge of basin.
3. Mop Hanger (-MH) and Mop Basin Hose & Bracket (-HH) provided for installation on mop basin adjacent walls.



2.6

A. Chicago Faucets No. 540-LD897SWXFABCP, wall mounted. 8" fixed centers, Hot and cold water sink faucet, chrome plated solid brass construction. 5 3/4" center to center rigid vacuum breaker spout with 3/4" male hose thread and pail hook. 2 3/8" metal lever handles with eight point tapered broach and secured blue and red buttons. Quarter-turn re-buildable compression cartridge, opens and closes 90°, closes with water pressure, features square tapered stem. Straight 2" inlet supply arm with wall flange with 1/2" NPT female thread inlet. Provide atmospheric vacuum breaker. ECAST® construction with less than 0.25% lead content by weighted average. Provide per ADA ANSI/ICC A117.1 requirements and shall be tested and

certified to industry standards: ASME A112.18.1/CSA B125, and NSF/ANSI 372 Low Lead Content.



B.

2.7 **P-5:** Under-Counter mounting; Provide sealant and under-counter mounting kit.

A. KOHLER Caxton K-2210, ADA vitreous china, 19" x 16". Rimless, oval design, front overflow.



B. **P-5** Faucet: TOTO Model # TEL105-D10ET; the faucet shall have hydro-powered self-generating, EcoPower System. The faucet shall have maximum of 10 seconds on demand flow (0.09gpc), or 20 seconds continuous flow (0.19gpc). Product shall have anti-scald shape memory alloy thermostatic mixing valve. Provide a TMV. Provide a polished chrome finish.



PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION - GENERAL

- A. Assemble and support fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Provide fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- C. Provide 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. Provide stops in locations where they can be easily reached for operation.
- D. Provide traps on fixture outlets as required.
 - 1. Provide level and plumb according to roughing-in drawings.
- E. Provide supports and connections to fixtures per manufacturer's instructions.
- F. Provide escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results for Plumbing" for escutcheons.
- G. Set floor mounted fixtures in a leveling bed of cement grout as per fixture manufacturer's instructions.
- H. Joint Sealing: Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Division 9.
- I. Wall Flange and Escutcheon Installation: Provide wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Provide deep-pattern escutcheons if required to conceal protruding fittings.

3.3 WATER CLOSET INSTALLATION

- A. Provide accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
- B. Provide lever-handle flushometer valves for accessible fixtures with handle mounted on open side of fixture. Provide actuators in locations that are easy for people with disabilities to reach.
- C. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- D. Provide toilet seats on water closets.

3.4 SINKS AND LAVATORIES

- A. Provide supports, affixed to building substrate, for wall-mounted lavatories.
- B. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls. Adjust water pressure at faucets to produce proper flow.
- C. Provide ADA pipe covering kit for supplies and drain exposed on wall hung lavatories.

3.5 HOOK UPS

- A. Foodservice Equipment: Provide rough-in piping, traps, tailpieces, indirect waste lines and make final and necessary connections for foodservice equipment. Provide faucets, spray units, drains, lever drains, vacuum breakers, solenoid valves, check-valves, flow control valves, water inlet fittings, filters, strainers, pressure reducing valves and gas valves furnished by foodservice equipment contractor. Provide condensate drain piping from cooler and freezer evaporators. Make all final and necessary plumbing connections.
- B. Provide plumbing hookups to Fixtures and Equipment Specified in Section 113100 "Residential Appliances". Connect fixtures and equipment with water supplies Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- C. Residential Dishwasher: When the sink is not equipped with a garbage disposal unit, the dishwasher waste shall be connected to the continuous waste of the sink using a wye-branch fitting, after passing through the required air gap fitting. The wye branch fitting may be installed in any vertical section of the continuous waste on the inlet side of the trap. The wye branch fitting shall not be installed in a horizontal run.

3.6 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. 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.

- C. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

3.7 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed. Check that fixtures are complete with trim, faucets, fittings, and other specified components. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- B. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- C. Operate and adjust fixtures. Replace damaged and malfunctioning fixtures, fittings, and controls.
- D. Adjust water pressure to produce proper flow and stream.
- E. Replace washers and seals of leaking and dripping faucets and stops.

3.8 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 and other fittings with manufacturers' recommended cleaning methods and materials. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts. Remove sediment and debris from drains.
- C. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

3.9 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless allowed in Division 1.

END OF SECTION 224000

SECTION 230500 – COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section applies to Division 21, 22, & 23 sections.

1.2 GENERAL

- A. This Section includes mechanical items common to all of this division specification sections.
- B. Provide services, skilled and common labor, and all apparatus and materials required for the complete installation as shown and within the intent of the contract documents, field conditions, and code requirements.
- C. The intention of these Contract Documents is to call for finished work, fully tested and ready for operation. Any components or labor not mentioned in the Contract Documents but required for functioning systems shall be provided. Should there appear to be any discrepancies or questions of intent, the Contractor shall refer the matter to the Architect/Engineer for decision before start of any related work.
- D. This contractor will be responsible to carry out the commissioning requirements specified. Refer to Division 1 for additional requirements.

1.3 MANUFACTURERS INSTRUCTIONS

- A. Provide equipment and components to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Follow manufacturer's instructions for inspection, start-up, calibration, and testing.

1.4 EFFICIENCY MAINE

- A. This project intends to pursue Efficient Maine prescriptive and/or custom incentives. The contractor shall participate in the activities associated with Efficiency Maine incentive approval process including but not limited to; preparation and submission of required incentive applications and the tracking and submission of measure specific invoices to Efficiency Maine within 60 days of the completion of the work.

- B. The contractor shall also:
 - 1. Become familiar with the Efficiency Maine Business Program including available incentives and the application and review process.
 - 2. <http://www.energymaine.com/at-work/business-programs/>
 - 3. Review plans and specifications for compliance with Efficiency Maine standards for applicable systems and technologies.
 - 4. Review plans and specifications for any and all incentive opportunities.
- C. The project schedule shall reflect and accommodate the time required to achieve application pre-approval from Efficiency Maine (EM). No equipment shall be purchased until pre-approval is received from EM.
- D. All invoices shall be forwarded to EM within 60 days of the completion of work. This deliverable shall be shown on the project schedule as a milestone date and coordinated with all contractors to assure compliance with this requirement.
- E. Efficiency Maine is available to assist in the application process and can be reached at 866-376-2463. Contractor must contact EM prior to submittals to review the project equipment and scope.
- F. As a minimum, obtain rebates for the following:

<p>Equipment eligible for CASH INCENTIVES</p> <hr/> <p>Ductless Mini-Split Heat Pump Systems</p> <ul style="list-style-type: none">• 1 Zone: \$500/system• 2 Zones: \$750/system• 3 Zones: \$1,000/system• 4 or more Zones: \$1,250/system

<p>Equipment eligible for INSTANT DISCOUNTS</p> <hr/> <p>Boilers \leq 500 MBtu/h (Natural Gas, Compressed Natural Gas, Oil and Propane)</p>
--

1.5 DEFINITIONS

- A. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. "Provide": Furnish and install, complete and ready for the intended use.

- C. "Shall": The word shall is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and procedures and from which no deviation is permitted.
- D. 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, crawlspace, and attics.
- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- H. 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.
- I. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

1.6 SUBMITTALS

- A. Provide in accordance with Division 1 of the specifications.

1.7 SUBSTITUTIONS

- A. Provide in accordance with Division 1 of the specifications.

1.8 QUALITY ASSURANCE

- A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.
- B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications." Comply with provisions in ASME B31 Series, "Code for Pressure Piping." Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- E. Electrical Characteristics for 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.
- F. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.
- G. Plumbing work shall be performed by, or under, the direct supervision of a licensed master plumber.
- H. Electrical work shall be performed by, or under, the direct supervision of a licensed electrician.
- I. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 1.
- B. Piping:
 - 1. Pipe and tube required by the applicable standard to be cleaned and capped shall be delivered to the job site with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
 - 2. Protect stored pipe and tube from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.
 - 3. Protect fittings, flanges, and piping specialties from moisture and dirt.
 - 4. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.10 COORDINATION

- A. Coordinate use of project space and sequence of installation of mechanical and electrical work, which is indicated diagrammatically on drawings. Follow routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- B. The drawings show the general arrangement of systems and equipment but do not show all required fittings and offsets that may be necessary to connect pipes and ductwork to equipment, and to coordinate with other trades. Provide all necessary fittings, offsets and runs based on

field measurements and at no additional cost. Coordinate with other trades for space available and relative location of equipment and accessories. Pipe and duct location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

- C. Corrections or comments made on the Shop Drawings during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.
- D. Coordinate use of project space and sequence of installation of work.
- E. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for installations. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- F. Coordinate requirements for access panels and doors for items requiring access that are concealed behind finished surfaces. Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.
 - 1. Access panels and doors are specified and provided by Division 8.

1.11 TEST ADJUST AND BALANCE READINESS

- A. The Contractor shall provide and coordinate the services of qualified, responsible sub-contractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting, and balancing period.
- B. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate the systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB.
- C. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The Contractor shall allow adequate time for the testing and balancing activities of the Owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.
- D. The Drawings and Specifications indicate valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB Firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.

- E. Complete operational readiness of the HVAC systems also requires that the following be accomplished:
1. Distribution Systems:
 - a. Verify installation for conformity to design. All supply, return, and exhaust ducts shall be terminated and tested as required by the Specification.
 - b. Dampers shall be properly located and functional. Dampers shall have tight closure and open fully with smooth and free operation.
 - c. Supply, return, exhaust, and transfer grilles, registers, diffusers, and terminal devices shall be installed and secured in a full open position.
 - d. Air handling systems, units, and associated apparatus shall be sealed to eliminate uncontrolled bypass or leakage of air. Final clean filters shall be in place, coils shall be clean with fins straightened, bearings properly greased, and the system shall be completely operational. The Contractor shall verify that all systems are operating within the design pressure limits of the piping and ductwork.
 - e. Check for proper sealing of air-handling unit components.
 - f. Thermal overload protection is in place for fans and other equipment. Bearings shall be greased. Belts shall be aligned and tight
 - g. Terminal units shall be installed and functional (i.e. controls functioning).
 2. Water Circulating Systems:
 - a. Verify installation for conformity to design. Hydronic systems are pressure tested, flushed, filled, and properly vented. Service and balance valves are fully open. Examine HVAC system and equipment installations to verify that indicated balancing devices are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation
 - b. All valves shall be set to their full open position. After the system is flushed and checked for proper operation, all strainers shall be removed and cleaned. The Contractor shall repeat the operation until circulating water is clean and then the start-up strainers shall be discarded. Bearings shall be greased.
 - c. Record pump motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating. Verify that the electrical heater elements are of the proper size and rating as per the starter manufacturer.
 - d. In preparation of TAB, water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and all air vents shall be installed at high points of systems and operating freely. Chemicals shall be added to closed systems to treat piping and inhibit corrosion. The system static pressure shall be adequate to completely fill the system without operating the pumps.
 - e. Check and set operating parameters of the heat transfer and control devices to the design requirements.
 - f. Proper balancing devices shall be in place and located correctly. These devices include but are not limited to flow meters, pressure taps, thermometer wells, balancing valves, etc. Heat transfer coils shall be checked for correct piping connections.

3. Automatic Controls

- a. The BAS Contractor shall verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.
- b. The BAS Contractor shall verify that all controlling instruments are calibrated and set for design operating conditions with the exception of components that require input from the TAB Agency, but a default shall be set. The Control Contractor shall cooperate with the TAB Agency and provide all software and interfaces to communicate with the system.
- c. The BAS Contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB Agency that the BAS is operational. The BAS Contractor shall provide technical support (technicians and necessary computers) to the TAB Agency for a complete check of these systems.
- d. Prior to occupancy, each ventilation system shall be tested to ensure that OA dampers operate properly in accordance with system design.
- e. Fire Alarm: Division 26 shall thoroughly check all detection devices, sequences, inter-locks, etc. before notifying the TAB Agency that the system is operational. Division 26 shall certify that the systems are totally operational to the Contractor prior to the TAB beginning.

PART 2 - PRODUCT

2.1 PRODUCT CRITERIA

- A. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
- B. Equipment Service: Products shall be supported by a service organization that maintains a complete inventory of repair parts and is located reasonably close to the site.
- C. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- D. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- E. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- F. Asbestos products or equipment or materials containing asbestos shall not be used.

2.2 PIPE JOINING MATERIALS

- A. Refer to individual Division 22 and 23 piping Sections for pipe, tube, and fitting materials and joining methods. Refer to individual piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. 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. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges. 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.
- D. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- E. Mechanical Coupling Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents and exterior environment. Gasket design shall be such that the entire coupling housing is isolated from the system contents to prevent galvanic action and inhibit galvanic corrosion.
- 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 alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- I. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Solvent Cements for Joining Plastic Piping: CPVC Piping: ASTM F 493. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 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. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling. Aboveground Pressure Piping: Pipe fitting.

- B. Plastic-to-Metal Transition Fittings: one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve; ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.4 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. Fittings shall match piping specifications. Threaded dielectric union, ANSI B16.39. Watts Series LF3000 (lead free) or approved equal. Flange union with dielectric gasket and bolt sleeves, ANSI B16.42. Dielectric flange fittings: Watts Series LF3100.

2.5 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Mechanical Sleeve Seals: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve; Thunderline Link-Seal, or approved equal.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Glass-reinforced nylon.
 - 3. Connecting Bolts and Nuts: Stainless steel, of length required to secure pressure plates to sealing elements.

2.6 ESCUTCHEONS

- A. Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated. Metals and finish shall conform to ASME A112.19.2. Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. ID

shall closely fit around pipe, tube, and insulation of insulated piping and an OD that completely cover the opening.

- B. All escutcheons shall have setscrews for maintaining a fixed position against a surface.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout. Characteristics: Post-hardening, volume adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications. Design Mix: 5000-psi, 28-day compressive strength. Packaging: Premixed and factory packaged.

2.8 ROOFING

- A. Coordinate roofing with Division 7.
- B. Roof Edge Protection System, required for any mechanical items located within 10 feet of roof edge.
 - 1. Roof edge protection system shall be KeeGuard Roof Edge Protection System, or approved equal. System shall be a counterweighted guardrail system with 42" min. height to provide code-compliant protection for mechanical equipment located less than 10 feet from the edge of the roof. System shall withstand a minimum load of 200 lbs. in any direction to all components per OSHA Regulation 29 CFR 1910.23.
 - 2. Components: Pipe: ASTM A53 1-1/2 inch schedule 40, Galvanized. Rails, Posts, and fittings: 1-1/2 inch diameter steel pipe, galvanized. Mounting Bases: Galvanized steel bases to have a rubber pad placed under the plate at the job site. Counterweights: Galvanized steel counterweights to have a rubber pad placed under the plate at the job site. Finish: galvanized mill finish to the requirements of ASTM A53. Provide per manufacturers recommendations.

2.9 VIBRATION ISOLATION

- A. All equipment shall be isolated to prevent vibration transmission to the building structure.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS

- A. Provide piping, ductwork, and equipment to allow maximum possible headroom unless specific mounting heights are indicated. Provide equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- B. Provide 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.
- C. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities.
- D. Any structural member weakened or impaired by cutting, notching, or otherwise shall be reinforced, repaired, or replaced so as to be left in safe structural condition in accordance with the local building code requirements.
- E. Provide piping and ductwork in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- F. Provide 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.
- G. Provide systems above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Provide piping to permit valve servicing.
- I. Provide equipment and other components to allow right of way for piping installed at required slope.
- J. Provide free of sags and bends.
- K. Provide unions or flanges at connections to equipment.
- L. Provide fittings for changes in direction and branch connections.
- M. Make allowances for application of insulation.
- N. Select system components with pressure rating equal to or greater than system operating pressure.
- O. Verify final equipment locations for roughing-in.
- P. Protection and Cleaning: Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items shall be replaced. Protect all finished parts of equipment. Close duct and pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and the relevant specification section specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel or groove plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux. Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8. Only brazing alloys having a liquid temperature above 1000°F shall be used.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Threaded joints shall have pipe joint compound or Teflon tape applied to the male threads only. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Provide gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. 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.
 - 4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPE PENETRATIONS & SLEEVES

- A. Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed.
- B. Refer to Section 230700 "Mechanical Insulation".
- C. Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve.
- D. Sleeve Clearance: Sleeve through floors, walls, partitions, and beams shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation.
- E. Provide sleeves for pipes passing through concrete and masonry construction. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint. Cut sleeves to length for mounting flush with both surfaces. Provide sleeves in new walls and slabs as new walls and slabs are constructed. Provide steel pipe sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Piping through concrete or masonry shall not be subject to any load from the building construction.
 - 1. Sleeves are not required in drywall construction.
 - 2. Sleeves are not required for core-drilled holes.
- F. To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1. For sleeves: Extend sleeve 1-1/2 inch above finished floor and provide sealant for watertight joint.
 - 2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
 - 3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- G. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7.
- H. Radon: There is a potential radon issue at this project location; floor penetrations shall be made with care. The floor assembly will be as shown on the architectural and structural plans. All ground floor penetrations including floor drains shall be sealed with polyurethane sealant. Installation must also conform to any requirements for radon intrusion. When applying sealant, make sure surfaces are clean and dry, and free of grit and that the surface temperature is above freezing (or as recommended by sealant manufacturer). Apply sealants in accordance with the manufacturer's recommended practice. Typical dimensions for caulk beads are 1/2 in. deep by 1/4 in. to 1/2 in. wide. It may be necessary to use backer rod when applying sealant in wide gaps.

I. Exterior- Pipe Penetrations:

1. Provide sleeve-seal systems in sleeves at service piping entries into building.
2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

J. Escutcheons: Provide for penetrations in finished spaces where pipes are exposed. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

K. Plastic and copper piping penetrating framing members, and within one-inch of the framing, shall be protected with 10-gauge steel nailing plates. The steel plate shall extend along the framing member a minimum of 1.5" beyond the OD of the pipe or tubing.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated: Provide unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment. Provide flanges in piping NPS 2-1/2 and larger, adjacent to valves and at final connection to each piece of equipment.

B. Provide dielectric fittings at connection between copper and ferrous metal.

C. Swing Connections for Expansion: Connect risers and branch connections to mains with at least five pipe fittings, including tee in main. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor 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. Provide fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.6 GROUTING

A. Provide in accordance with Division 3.

B. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors. Clean surfaces that will come into contact with grout. Provide forms as

required for placement of grout. Avoid air entrapment during placement of grout. Place grout, completely filling equipment bases. Place grout on concrete bases and provide smooth bearing surface for equipment. Place grout around anchors. Cure placed grout.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Provide in accordance with Division 5.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment. Field Welding: Comply with AWS D1.1.

3.8 FIRESTOPPING

- A. Provide through-penetration firestop systems. Refer to Division 7 for materials. Seal penetrations through fire-or smoke-rated wall, partition, ceiling, or roof assemblies with firestopping systems. Refer to Architectural plans for location of rated assemblies.

3.9 PAINTING

- A. Painting of plumbing and mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 CONCRETE HOUSEKEEPING PADS

- A. Provide in accordance with Division 3.
- B. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with equipment manufacturer to ensure adequate space, embedment and prevent edge breakout failures.
- C. Construct concrete bases not less than 4 inches larger in both directions than supported unit.
- D. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. [Refer to seismic restraint manufacturer's written instructions.]
- E. Provide 4" high (+/-) housekeeping pads for the following:
 - 1. Boilers
 - 2. DHW Heaters
 - 3. Expansion Tanks
 - 4. As noted on plans
 - 5. As recommended by Equipment manufacturer.

3.11 ROOFING

- A. Refer to Division 7.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

3.12 PROJECT CLOSEOUT

- A. Provide Demonstration and Training in accordance Division 1.
- B. Provide Project Record Documents in accordance with Division 1.
- C. Follow Closeout procedures as per Division 1.
- D. Provide Operation and Maintenance information in accordance with Division 1. In addition, provide the following.
 - 1. An O&M manual describing basic data relating to the operation and maintenance of systems and equipment as installed.
 - 2. HVAC control information consisting of diagrams, schedules, control sequence narratives, and maintenance and/or calibration information.
 - 3. TAB report
 - 4. Construction drawings of record, control drawings and final design drawings.

END OF SECTION 230500

SECTION 230519 – THERMOMETERS AND PRESSURE GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section “Common Work Results for Mechanical”
 - 2. Mechanical equipment Sections that specify meters and gauges as part of factory-fabricated equipment.

1.2 SUMMARY

- A. This Section includes thermometers and pressure gauges.

1.3 ACTION SUBMITTALS

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each gauge, fitting, specialty, and accessory specified.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft
 - 2. Weksler
 - 3. Ernst Gauge Co.
 - 4. Trerice: H. O. Trerice Co.
 - 5. Weiss Instruments, Inc.

2.2 THERMOMETERS

- A. Liquid-In-Glass Industrial Thermometers: shall be a blue reading (Fill Type Spirit: Blue colored, organic) liquid-in-glass adjustable angle type, 9" scale, cast aluminum case with cured polyester powder coating, clear acrylic window and brass separable thermowell. Thermometers will be Trerice BX9 Series or approved equal.
- B. Scale Range: Temperature ranges for services listed are as follows: The proper range will be selected so that the operating temperature of the material being measured will fall approximately in the middle of the scale.
1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 2. Domestic Cold Water: 0 to 100°F, with 1°F scale divisions.
 3. Heating Hot Water: 30 to 180°F, with 2°F scale divisions.
- C. Thermowells: Provide fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
1. Material: Brass, for use in copper piping.
 2. Material: Stainless steel, for use in steel piping.
 3. Where insulation thickness exceeds 2", a longer stem thermometer will be used with an extension neck brass separable thermowell. The extension neck will be at least 2" long.
 4. Thermometers for measuring fluid temperatures will have stems with insertion lengths of roughly half of the pipe diameter; minimum insertion length will be 2".
 5. Cap: Threaded, with chain permanently fastened to socket. Heat-Transfer Fluid: Mixture of graphite and glycerin.

2.3 PRESSURE GAUGES

- A. Pressure gauges shall be 3½" dial size with a flangeless cast aluminum case, stainless steel friction ring and glass window. Movement will be brass with a bronze bourdon tube and brass socket. Dial face will be white with black figures; pointer will be friction adjustable type. Accuracy shall be ±1% of scale range, ASME B40.1 Grade 1A. Pressure gauges will be Trerice No. 600CB approved equal.
1. Connector: Brass, NPT 1/4.
 2. Units of Measure: PSI
 3. Provide silicone-damped movement.
 4. Range: The proper range shall be selected so that the average operating pressure falls approximately in the middle of the scale selected.
 5. Provide pressure-gauge needle valve and snubber (Trerice No. 872 pressure snubbers) in piping to pressure gauges; ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.
 6. Needle Valves: Trerice 735 Series; NPS 1/4 brass or 316 stainless steel needle type.
- B. Scale Range: Pressure ranges for services listed are as follows: The proper range will be selected so that the operating pressure of the material being measured will fall approximately in the middle of the scale.

1. Domestic Hot Water: 0 to 100 psi
2. Domestic Cold Water: 0 to 100 psi.
3. Heating Hot Water: 0 to 60 psi.

2.4 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Peterson Equipment Co., Inc.
 3. Trerice, H. O. Co.
 4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 5. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide according to manufacturer's written instructions for applications where used.
- B. Provide thermometers and adjust vertical and tilted positions. Provide thermowells with extension on insulated piping. Provide separable sockets in vertical position in piping tees.
- C. Provide pressure gauges in piping tees with pressure-gauge valve located on pipe at most readable position. Provide valve and snubber in piping for each pressure gage for fluids.
- D. Thermometers are required at the following locations and where shown on drawings:
 1. HW heating coil inlet and outlet.
 2. Radiant manifold HWS and HWR from boiler.
 3. Radiant manifold HWR from manifold prior to mixing valve.
 4. DHW maker inlet and outlet as well as DHW recirculation pump location.
 5. HW inlet and outlet at DHW mounted heating module.

- E. Pressure gauges are required at the following locations and where shown on drawings:
 - 1. Inlet and outlet to all pumps and circulators.
 - 2. Domestic cold water entrance before water meter and after pressure reducing valve.
 - 3. Heating hot water before and after pressure reducing valve serving makeup water.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping and specialties. Provide adjacent to machines and equipment to allow service and maintenance. Connect per manufacturers recommendations.

3.3 ADJUSTING AND CLEANING

- A. Calibrate according to manufacturer's written instructions, after installation.
- B. Adjust faces to proper angle for best visibility.
- C. Clean windows and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 230519

SECTION 220529 - HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for Mechanical"
 - 2. Division 23 Section "Mechanical Insulation"

1.2 SUMMARY

- A. This Section includes hangers and supports for piping and equipment.

1.3 ACTION SUBMITTALS

- A. Submit product data on all hanger and support devices, including shields and attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Provide in accordance with MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports- Selection and Application
- B. Steel pipe hangers and supports shall have the manufacturer's name, part number, and applicable size stamped in the part itself for identification.

- C. Pipe Hangers, Supports, and Components: The materials of all pipe hanging and supporting elements shall be in accordance with MSS SP-58.
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line Systems, Inc.
 - 2. Carpenter & Patterson, Inc.
 - 3. Grinnell Corp.
 - 4. Piping Technology & Products, Inc.
 - 5. Unistrut
- B. Conform to Manufacturers Standardization Society ANSI/MSS SP-69 & SP-58 – Types indicated below.
- C. Hangers:
 - 1. Uninsulated pipes 2 inch and smaller:
 - a. Adjustable steel swivel ring (band type) hanger, Type 10, B-Line B3170.
 - b. Adjustable steel swivel J-hanger, Type 5, B-Line B3690.
 - c. Malleable iron ring hanger, Type 12, B-Line B3198R or hinged ring hanger, B3198H.
 - d. Adjustable steel clevis hanger, Type 1, B-Line B3100.
 - 2. Uninsulated pipes 2-1/2 inch and larger:
 - a. Adjustable steel clevis hanger, Type 1, B-Line B3100.
 - b. Pipe roll with sockets, Type 41, B-Line B3114.
 - c. Adjustable steel yoke pipe roll, Type 43, B-Line B3110.
 - 3. Insulated pipe- Hot piping:
 - a. 2 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. Type 1, B-Line B3100 with Type 40, B-Line B3151 series insulation protection shield.
 - b. 2-1/2 inch and larger pipes: Type 41 or Type 43 with Type 39A/39B, B3160-B3165 series pipe covering protection saddle.

4. Insulated pipe- Cold piping:
 - a. 5 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. Type 1, B-Line B3100 with Type 40, B-Line B3151 series insulation protection shield.
- D. Pipe Clamps: When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, Type 4, B-Line B3140. For insulated lines use double bolted pipe clamps, Type 3, B-Line B3144.
- E. Multiple or Trapeze Hanger
 1. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8 inch minimum, B-Line B22 strut or stronger as required.
 2. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe, B-Line B2000 Series.
 3. For pipes subjected to axial movement: Strut mounted roller support, B-Line B3126. Use pipe protection shield or saddles on insulated lines. Strut mounted pipe guide, B-Line B2417.
- F. Wall Supports
 1. Pipes 4 inch and smaller: Carbon steel J-hanger, B-Line B3690.
 2. Pipes larger than 4 inch: Welded strut bracket and pipe straps, Type 31 light welded steel bracket, B-Line B3064. Provide Type 32 or Type 33 for heavier loads.
- G. Floor Supports
 1. Hot piping under 6 inch and all cold piping: Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. Type 38 adjustable pipe saddle, B-Line B3093 and B3088T base stand; or Type 39, B3090 and B3088 base stand. Pipe saddle shall be screwed or welded to appropriate base stand.
- H. Vertical Supports: Steel riser clamp sized to fit OD of pipe, Type 8, B-Line B3373.
- I. Copper Tubing Supports
 1. Hangers shall be sized to fit copper tubing outside diameters.
 - a. Adjustable steel swivel ring (band type) hanger, Type 10, B-Line B3170CT.
 - b. Malleable iron ring hanger, Type 12, B-Line B3198RCT or hinged ring hanger B3198HCT.
 - c. Adjustable steel clevis hanger, Type 1, B-Line B3104CT.
 2. For supporting copper tube to strut use epoxy painted pipe straps sized for copper tubing, B-Line B2000 series, or plastic inserted vibration isolation clamps, B-Line BVT series.

- J. Plastic Pipe Supports: V-Bottom clevis hanger with galvanized 18-gauge continuous support channel, Type 1, B-Line B3106 and B3106V plastic pipe support channel, to form a continuous support system for plastic pipe or flexible tubing.
- K. Supplementary Structural Supports: Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch by 1-5/8 inch or greater as required by loading conditions. Submit designs for pipe tunnels, pipe galleries, etc., to engineer for approval. Use clamps and fittings designed for use with the strut system.

2.2 UPPER ATTACHMENTS

A. Beam Clamps

- 1. Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
- 2. C-Clamps shall have locknuts and cup point set screws, Type 23, B-Line B351L. Refer to manufacturer's recommendation for setscrew torque. Retaining straps shall be used to maintain the clamps position on the beam where required.

B. Concrete Inserts

- 1. Cast in place spot concrete inserts shall be used where applicable; either steel or malleable iron body, Type 18, B-Line B2500 or B3014. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rod sizes, B-Line N2500 or B3014N series.
- 2. Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with Styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete, B-Line B22I, 32I, or 52I. Select channel nuts suitable for strut and rod sizes.

2.3 VIBRATION ISOLATION AND SUPPORTS

- A. For air conditioning and other vibrating system applications, use a clamp that has a vibration dampening insert and a nylon inserted locknut. For copper and steel tubing use B-Line BVT-Series Vibraclamps.
- B. For larger tubing or piping subjected to vibration, use neoprene or spring hangers as required.
- C. For base mounted equipment use vibration pads, molded neoprene mounts, or spring mounts as required.

2.4 ACCESSORIES

- A. Hanger Rods shall be threaded both ends, or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
- B. Shields shall be 180 degree galvanized sheet metal, 12 inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line B3151.
- C. Pipe protection saddles shall be formed from carbon steel, 1/8 inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.

2.5 FINISHES

- A. Indoor Finishes:
 - 1. Hangers and clamps for support of bare copper piping shall be coated with copper colored epoxy paint, B-Line Dura-Copper®. Additional PVC coating of the epoxy painted hanger shall be used where necessary.
 - 2. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633; or shall have an electro-deposited green epoxy finish, B-Line Dura-Green®.
 - 3. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line Dura-Green®.
- B. Outdoor Finishes: Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.
- C. Under Slab Finishes: Hangers and strut located under slab shall be type 316 stainless steel with stainless steel hardware.

2.6 METAL FRAMING SYSTEMS (“UNISTRUT”)

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.
 - b. Flex-Strut Inc.
 - c. Thomas & Betts Corporation.
 - d. Unistrut Corporation; Tyco International, Ltd.
 - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with in-turned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Unistrut Perma-green or similar.

2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
 5. Pipe Supports, multiple pipes: Galvanized-steel, clevis-type pipe hangers.
- E. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. The following installation requirements apply to all under slab piping.
- B. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual

pipe hangers. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

- D. Metal Framing System Installation: Provide per manufactures recommendations and calculations.
- E. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- F. Fastener System Installation: Provide powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Provide fasteners according to powder-actuated tool manufacturer's operating manual. Provide mechanical-expansion anchors in concrete after concrete is placed and completely cured. Provide fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation: Provide per manufactures recommendations and calculations. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- H. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Provide hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- L. Provide building attachments within concrete slabs or attach to structural steel. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by plumbing code and ASME B31.9 for building services piping. Piping shall be supported in such a manner as to maintain its alignment and prevent sagging.
- O. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

- b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- E. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- F. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.7 HANGER SPACING

- A. Support piping and tubing not listed below according to MSS SP-69 and manufacturer's written instructions.
- B. Provide hangers for steel piping with the following maximum horizontal spacing and minimum rod sizes:
 - 1. NPS 1/2": Maximum span, 6 feet; minimum rod size, 3/8 inch.
 - 2. NPS 3/4 to 1: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/4: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 6. NPS 2-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 7. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 8. NPS 4: Maximum span, 10 feet; minimum rod size, 5/8 inch.
 - 9. NPS 5: Maximum span, 10 feet; minimum rod size, 5/8 inch.
 - 10. NPS 6: Maximum span, 10 feet; minimum rod size, 3/4 inch.
 - 11. NPS 8: Maximum span, 10 feet; minimum rod size, 3/4 inch.
 - 12. NPS 10: Maximum span, 10 feet; minimum rod size, 7/8 inch.
 - 13. NPS 12: Maximum span, 10 feet; minimum rod size, 7/8 inch.
- C. Provide hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:
 - 1. NPS 1/2 and 3/4: Maximum span, 5 feet; minimum rod size, 3/8 inch.
 - 2. NPS 1 to 1-1/2": Maximum span, 6 feet; minimum rod size, 3/8 inch.
 - 3. NPS 2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
 - 4. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 1/2 inch.

5. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
6. NPS 4: Maximum span, 10 feet; minimum rod size, 1/2 inch.
7. Maximum vertical steel and copper pipe attachment spacing: 10 feet.

D. Piping Hangers for Plastic Piping:

1. Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
2. In systems where large fluctuations in temperature occur, allowances must be made for expansion and contraction of the piping system. Since changes in direction in the system are usually sufficient to allow for expansion and contraction, hangers must be placed so as not to restrict this movement.
3. Hangers shall not compress, distort, cut or abrade the piping. All piping shall be supported at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal. Pipe should also be supported at all branch ends and at all changes of direction.
4. Hangers shall be placed next to the pipe joint not more than 18" from the point joint.
5. Maximum horizontal spacing and minimum rod diameters (pipe temperature 100°F or lower).

a. Solvent cemented PVC

- 1) NPS 1 and smaller: 48" with 3/8-inch rod.
- 2) NPS 1-1/4 to NPS 3: 48" with 3/8-inch rod.
- 3) NPS 3: 48" with 1/2-inch rod.
- 4) NPS 4: 48" with 5/8-inch rod.
- 5) NPS 6 and 8: 48" with 3/4-inch rod.

b. Solvent cemented CPVC

- 1) NPS 1 and smaller: 36" with 3/8-inch rod.
- 2) NPS 1-1/4 to NPS 3: 48" with 3/8-inch rod.
- 3) NPS 3: 48" with 1/2-inch rod.
- 4) NPS 4: 48" with 5/8-inch rod.
- 5) NPS 6 and 8: 48" with 3/4-inch rod.

c. PEX or PP

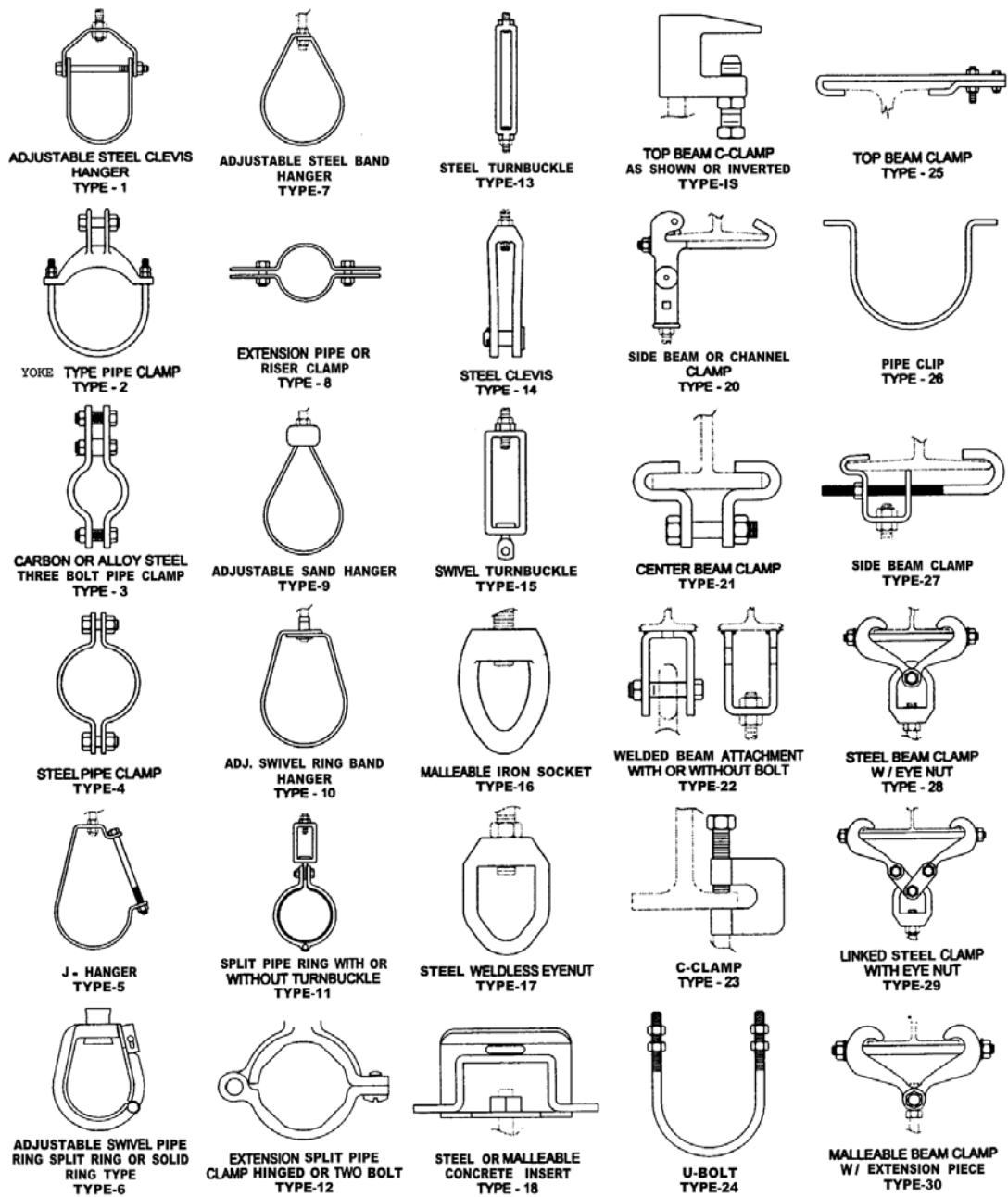
- 1) NPS 1 and smaller: 32" with 3/8-inch rod.
- 2) NPS 1-1/4 to NPS 3: 48" with 3/8-inch rod.
- 3) NPS 3: 48" with 1/2-inch rod.

6. Provide supports for vertical piping every 10 feet.

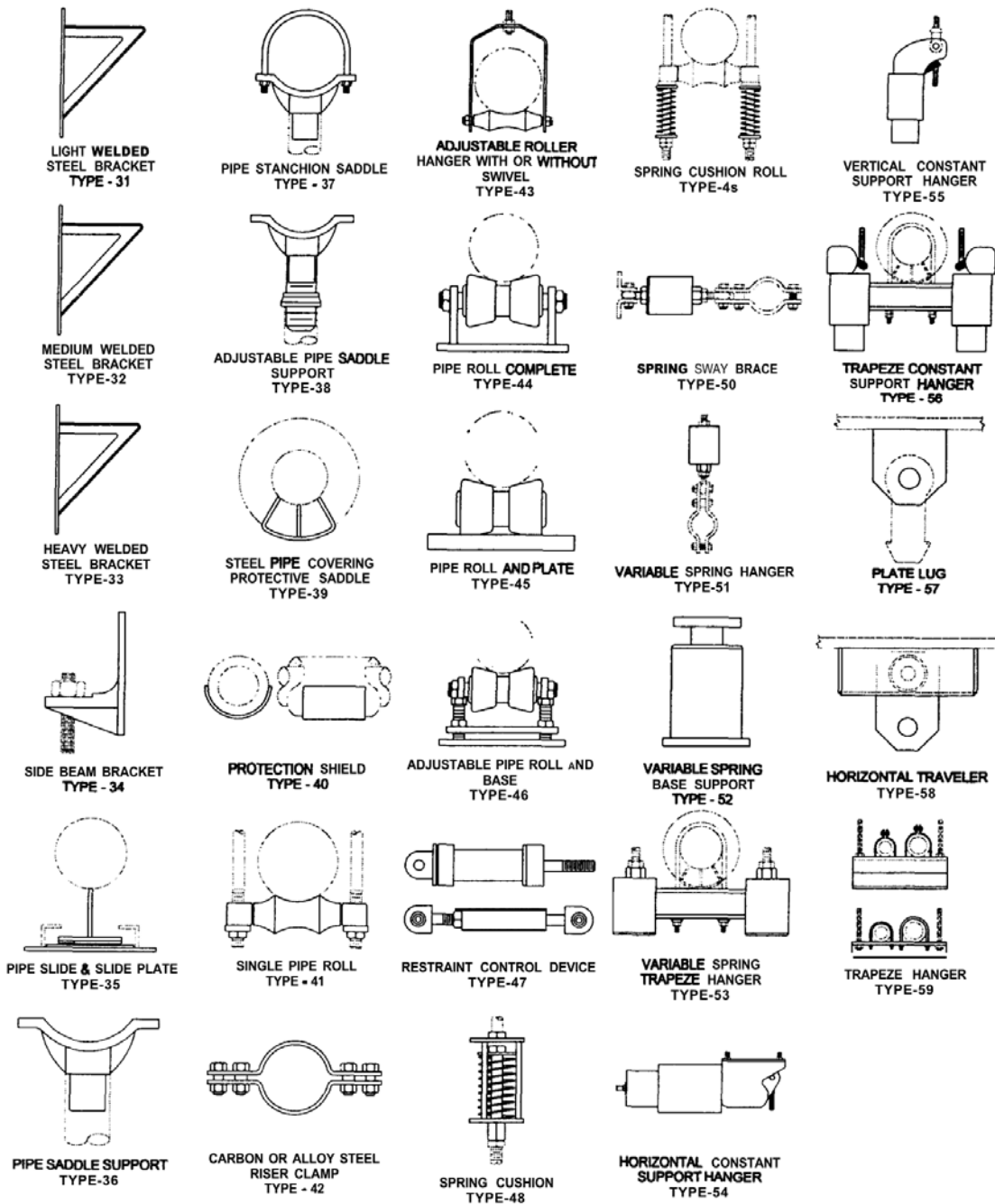
E. Support vertical piping independently of connected horizontal piping. Support vertical pipes at base and at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

F. Place a hanger within 12 inches of each horizontal elbow.

3.8 MSS SP-69 REFERENCE



A.



END OF SECTION 230529

SECTION 230553 – IDENTIFICATION FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 23 Section "Common Work Results for Mechanical"

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Valve numbering scheme. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Provide identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Terminology: Match schedules as closely as possible.

- B. Tag and description: Example: “EF-1 - Bathroom Exhaust”
- C. Equipment Markers: Custom Vinyl Decals with a clear polyester overlamine to endure outdoor conditions and are UV and scuff resistant. Decals shall be made of flexible vinyl with a permanent pressure-sensitive adhesive backing suitable for curved surfaces. Service temperature range of -40°F to 176°F.
- D. In addition to the equipment tag, equipment located above the ceiling that requires servicing shall be labeled on the ceiling grid using a labeling machine.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Seton, Brady, or approved equal; preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length. Size of letters and length of color field per ASME A13.1.
 - 3. Pipes with OD, Including Insulation; Full-band snap-around pipe markers extending 360 degrees around pipe at each location.
 - 4. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
 - 5. Minimum length of color field and size of letters shall be in accordance with Plumbing Code requirements.
- B. Types:
 - 1. Self-adhesive type: Seton Opti-Code.
 - 2. Snap-around type: Seton Setmark.
 - 3. Wrap-around type: Seton Ultra-mark; PVF over-laminated polyester construction seals in and protects graphics; suitable for outdoor or harsh environments.

2.3 VALVE TAGS & SCHEDULES

- A. Valve Tags: Stamped or engraved 1-1/2" round with 1/4-inch letters for piping system legend and 1/2-inch black-filled numbers, with numbering scheme; 3/16" hole for fastener; Material: 19-gauge brass; Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. 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: aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 22 or 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Provide equipment markers on each item of scheduled 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.
- B. Equipment located above the ceiling that requires servicing shall be labeled on the ceiling using a labeling machine.
1. Ceilings 10 feet and lower: Letters shall be 1/4" high, black.
 2. Ceilings higher than 10 feet: Letters shall be 3/8" high, black.
 3. Label all equipment above ceiling that requires servicing or access.

3.3 PIPING IDENTIFICATION

- A. Provide manufactured pipe markers indicating service on each piping system.
1. Provide pipe markers to manufacturer's instructions.
 2. Identify piping, concealed or exposed. Include service and flow direction.
 3. Provide in clear view and align with axis of piping.
 4. Locate identification at maximum 20 feet centers on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
 5. At access doors and similar access points that permit view of concealed piping.
 6. At least one per room.
- B. Apply "Electric Traced" labels to the outside of heat-traced insulation.
- C. Unions covered by insulation: Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

3.4 VALVE-TAG INSTALLATION

- A. Provide tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Mount valve schedule on wall in accessible location in each major equipment room. Provide (2) copies of valve schedules burned to a DVD or memory stick; Word or Excel format.

3.5 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.6 CLEANING

- A. Clean faces of mechanical identification devices.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes Testing, Adjusting, & Balancing

1.3 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
 - 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.4 ACTION SUBMITTALS

- A. Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing." TAB firm's forms approved by Architect. TABB "Contractors Certification Manual."

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC, TABB, or NEBB. Provide a guarantee on NEBB, AABC, or TABB forms stating that the balancing contractor 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.
 3. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following: Review field data reports to validate accuracy of data and to prepare certified TAB reports. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
 - C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
 - D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.

- H. Examine HVAC equipment and verify that equipment is installed per manufacturers recommendations with functioning controls and ready for operation.
- I. Hydronic Systems: Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows. Examine heat-transfer coils for correct piping connections and for clean and straight fins. Examine system pumps to ensure absence of entrained air in the suction piping.
- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.
 - 2. Hydronics:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Strainers are pulled and cleaned.

- f. Control valves are functioning per the sequence of operation.
- g. Shutoff and balance valves have been verified to be 100 percent open.
- h. Pumps are started and proper rotation is verified.
- i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
- j. Variable-frequency controllers' startup is complete and safeties are verified.
- k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to the mechanical insulation specification.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, VFD's, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Locate start-stop and disconnect switches, electrical interlocks, VFD's, and motor starters. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check dampers for proper position to achieve desired airflow path.
- F. Check for airflow blockages.
- G. Check condensate drains for proper connections and functioning.
- H. Check for proper sealing of air-handling-unit components. Verify that air duct system is sealed as specified in the ductwork specification.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
 - a. Set for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage all 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.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Measure and record all operating data.
6. Record final fan-performance data.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
 1. Check liquid level in expansion tank.
 2. Check highest vent for adequate pressure.
 3. Check flow-control valves for proper position.
 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 5. Verify that motor starters are equipped with properly sized thermal protection.
 6. Check that air has been purged from the system.
- D. Measure total water flow.
 1. Position valves for full flow through coils.
 2. Determine flow by pump TDH.
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gage heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- E. Adjust flow-measuring devices installed in mains and branches to design water flows.
 1. Measure flow in main and branch pipes.
 2. Adjust main and branch balance valves for design flow.
 3. Re-measure each main and branch after all have been adjusted.

- F. Adjust flow-measuring devices installed at terminals for each space to design water flows.
 - 1. Measure flow at terminals.
 - 2. Adjust each terminal to design flow.
 - 3. Re-measure each terminal after it is adjusted.
 - 4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
 - 5. Perform temperature tests after flows have been balanced.

- G. Verify final system conditions as follows:
 - 1. Re-measure and confirm that total water flow is within design.
 - 2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
 - 3. Mark final settings.
 - 4. Verify that memory stops have been set.

3.7 PROCEDURES FOR BOILERS

- A. Hydronic Boilers:
 - 1. Measure and record entering- and leaving-water temperatures.
 - 2. Measure and record water flow.
 - 3. Record relief valve pressure setting.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Airflow.

- B. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.

3.9 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 - 1. Verify temperature control system is operating within the design limitations.

2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.10 PROCEDURES FOR DOMESTIC HOT WATER RECIRCULATION SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system.

- B. System Diagrams: Include schematic layouts of as-built domestic hot water systems. Present each system with single-line diagram and include the following:

1. Water flow rates.
2. Pipe and valve sizes and locations.
3. Recirculation valve settings/flows

- C. Balancing shall include the following minimum data:

1. Pump flow
2. Balancing valve flows: proportionally balance flow to each recirculation loop.

- D. Pumps:

1. Adjust balancing valves at pumps to obtain design water flow. Record pressure rise across pumps and GPM flow from pump curve. Permanently mark the balanced position for each valve. (Note: If discharge valves on the pumps are used for balancing, record the head being restricted by the valves).
2. Do not deadhead the pumps. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded. Running amps and brake horsepower of pump motor under full flow and no flow conditions.
3. Calculate impeller size by plotting the shutoff head on pump curves and include the following pump test report data:
4. 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. Pump rpm.
- i. Impeller diameter in inches.
- j. Seal type.
- k. Motor Data: as specified herein before.

3.11 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.13 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Flow curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for OA-RA-EA dampers.
 - b. Conditions of filters.
 - c. VFD settings for variable-air-volume systems.
 - d. Settings for supply-air, static-pressure controller.
 - e. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Flow rates.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Terminal units.
 5. Balancing stations.
 6. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.

- g. Discharge arrangement.
 - h. Number, type, and size of filters.
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
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. Coil static-pressure differential in inches wg.
 - g. Outdoor airflow in cfm.
 - h. Return airflow in cfm.
 - i. Outdoor-air damper position.
 - j. Return-air damper position.
 - k. VFD Hz.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
- a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch
 - f. Make and model number.
 - g. Face area in sq. ft.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
 - b. Air pressure drop in inches wg.
 - c. Water flow rate in gpm.
 - d. Water pressure differential in feet of head or psig.
 - e. Entering-water temperature in deg F.
 - f. Leaving-water temperature in deg F.

- G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Motor horsepower and rpm.
 - i. Motor volts, phase, and hertz.
 - j. Motor full-load amperage and service factor.
 - k. Sheave make, size in inches, and bore.
 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. Motor voltage at each connection.
 - i. Motor amperage for each phase.
- H. Air-to-Air Energy-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: as specified herein before.
 3. Test Data (Indicated and Actual Values):
 - a. Total exhaust airflow rate in cfm.
 - b. Outside airflow rate in cfm.
 - c. Total exhaust fan static pressure in inches wg.
 - d. Total outside-air fan static pressure in inches wg.
 - e. Pressure drop on each side of heat exchanger in inches wg.
 - f. Exhaust air temperature entering in deg F.
 - g. Exhaust air temperature leaving in deg F.

- h. Outside-air temperature entering in deg F.
- i. Outside-air temperature leaving in deg F.

I. Fan Test Reports, 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.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.

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.

J. 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. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.

- b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
- L. Terminal Unit Coil Reports: For coils of terminal units, include the following:
- 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
- M. Instrument Calibration Reports:
- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.
- 3.14 VERIFICATION OF TAB REPORT
- A. Owner or Commissioning authority will randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 - B. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

- C. 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.
- D. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
- E. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

- A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION – 230700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 7 for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Hangers and Supports for Piping and Equipment" for pipe insulation shields and protection saddles.
 - 4. Division 23 Section "Metal Ducts" for duct liner.
 - 5. Division 23 Section "Heat Tracing for Piping"

1.2 SUMMARY

- A. This Section includes insulation and related components.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, Greenguard Certification, thickness, and jackets (both factory and field applied, if any), for each type of product indicated. For adhesives and sealants, provide documentation including printed a statement of VOC content.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- C. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- C. Store tapes, adhesives, mastics, cements, and insulation materials in ambient conditions in accordance with the recommendations of the manufacturer.
- D. Follow manufacturer's recommended handling practices.
- E. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- F. Fiber Glass and Mold: Contractor shall take precaution to protect insulation. Any fiber glass insulation that becomes wet or torn should be replaced at no additional cost. Air handling insulation used in the air stream must be discarded if exposed to water.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields. Coordinate clearance requirements with other trades for insulation application.
- B. Schedule insulation application after testing systems. Insulation application may begin on segments of systems that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Certainteed
 - 2. Knauf
 - 3. Owens-Corning
 - 4. John Mansville
 - 5. Armstrong
 - 6. Aeroflex USA
 - 7. Nomaco K-Flex

2.2 PIPING INSULATION MATERIALS

A. General

1. Supply fiber glass products that have achieved GREENGUARD Children & Schools Certification.
2. Surface Burning Characteristics: Insulation and related materials shall have surface burning characteristics determined by test performed on identical products per ASTM E 84 mounted and installed as per ASTM E 2231. All testing shall be performed by a testing and inspecting agency acceptable to authorities having jurisdiction. Insulation, jacket materials, adhesives, mastics, tapes and cement material containers shall be labeled with appropriate markings of applicable testing and inspecting agency. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. Supply fiber glass products that are manufactured using a certified 25 % minimum recycled content.

B. Provide thermal hanger shields as specified in Section 230529 "Hangers and Supports for Piping and Equipment".

C. Glass Fiber:

1. Knauf 1000° Pipe Insulation with ECOSE Technology meeting ASTM C547 Type IV Grade A, ASTM C585, and ASTM C795; rigid, molded, noncombustible per ASTM E136; k value: ASTM C335, 0.23 at 75°F mean temperature. Maximum Service Temperature: 1000°F, or Johns Manville's Micro-Lok® HP meeting ASTM C547, Type I, maximum service temperature of 850°F meeting the other requirements. Vapor Retarder Jacket: ASJ/SSL conforming to ASTM C1136 Type I, secured with self-sealing longitudinal laps and butt strips.
2. PVC Fitting Covers: The Proto Fitting Cover System or Johns Manville Zeston® polyvinyl chloride (PVC) parts shall consist of one piece and two piece pre-molded high impact UV-resistant PVC fitting covers with fiberglass inserts and accessories, which include elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings. Fittings shall be made of Zeston® or LoSMOKE® grade PVC, 25/50 rated per ASTM E-84. Thermal Value of fiberglass insert: K value of 0.26 at 75°F; resistance to fungi and bacteria. (ASTM G 21, ASTM G 22): does not promote growth of fungi or bacteria.

D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Materials shall have a maximum thermal conductivity of 0.27 Btu-in/h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
4. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure-A, latest revision.

5. Materials shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.
 6. Provide Armaflex WB finish for outdoor exposed piping.
- E. Closed Cell Pipe Insulation: Pittsburgh Corning Foamglas, or approved equal; a lightweight, rigid insulating material composed of millions of completely sealed glass cells, each an insulating space. ASTM C 552-00 "Specification for Cellular Glass Thermal Insulation" operating temperatures from -450°F to +900°F; water permeability 0.00 perm-inch.
- F. Pipe & Tank Insulation: Glass Fiber, Knauf with ECOSE Technology or equivalent; semi-rigid, limited combustible meeting requirements of NRC 1.36; ASTM C 795 and MIL-I-24244 C; k value: ASTM C 177, 0.25 at 75°F mean temperature. Maximum Service Temperature: 850°F. Compressive Strength: not less than 150 PSF @ 10% deformation for 2 inch thickness per ASTM C 165. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type II. Johns Manville Micro-Flex[®] Large Diameter Pipe and Tank Wrap meeting ASTM C1393, Type III. Limited combustible meeting k value: ASTM C 177, 0.25 at 75°F mean temperature. Maximum Service Temperature: 850°F. Compressive Strength: not less than 150 PSF @ 10% deformation for 2 inch thickness per ASTM C 165. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type II

2.3 FIELD-APPLIED JACKETS FOR PIPING

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. PVC: Johns Manville's Zeston[®] PVC fittings, jacketing, and accessories or Proto Corporation 25/50 or Indoor/Outdoor, UV-resistant fittings, jacketing and accessories, white. Fitting cover system consists of pre-molded, high-impact PVC materials with fiber glass inserts. Fiber glass insert has a thermal conductivity (k value) of 0.26 at 75° F mean temperature. Closures: stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.

2.4 DUCTWORK INSULATION MATERIALS

- A. Flexible Fiber Glass Blanket: Johns Manville's Microlite[®] XG Duct Wrap or Knauf Friendly Feel[®] Duct Wrap with ECOSE Technology meeting ASTM C553 Types I, II and III, and ASTM C1290; GREENGUARD certified; flexible, limited combustible; k value: ASTM C177, 0.29 at 75°F mean temperature. Maximum Service Temperature: faced: 250°F; unfaced: 350°F. Vapor Retarder Jacket: FSK conforming to ASTM C1136 Type II. Installation: Maximum allowable compression is 25%. Securement: Secured in place using outward cinching staples in combination with appropriate pressure-sensitive aluminum foil or PSK tape, or in combination with glass fabric and vapor retarder mastic. Density: concealed areas: Minimum 0.75 PCF; exposed areas: Minimum 1.0 PCF.
- B. Rigid Fiber Glass Board: Johns Manville's 817 Series Spin-Glas[®] or Knauf Insulation Board with ECOSE Technology meeting ASTM C 612 Type IA and IB; rigid. Maximum Service Temperature: 450°. Density: Minimum 6 PCF; k value: ASTM C177, 0.22 at 75°F mean temperature. Vapor Retarder Jacket: ASJ conforming to ASTM C1136 Type I, or FSK or PSK conforming to ASTM C1136 Type II in combination with protective jacket where necessary.

2.5 ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under this section shall include (but not be limited to):
 - 1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
 - 2. Adhesive: As recommended by insulation material manufacturer. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated
 - 3. Support Materials - Hanger straps, hanger rods, saddles, support rings
- B. All accessory materials shall be installed in accordance with manufacturer's instructions.
- C. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

2.6 SELF-REGULATING ELECTRICAL HEAT TRACING SYSTEM

- A. Systems shall meet requirements of the National Electrical Code (NEC), Section 427.
- A. Description: Self-regulating freeze protection heat trace system as manufactured by Raychem (or engineer pre-approved alternate). Model 5-XL2CR (208-277v). System shall be installed according to manufacturer's requirements including the testing of the electrical insulation properties of each section of the system using a 1000-Vdc Megger. Minimum insulation resistance shall be 20 megohms or greater.
- B. Provide one (1) Raychem ECW-GF electronic controller at Lobby 500 with integrated 30ma GFPE protection, 25ft temperature sensor, NEMA 4X enclosure and AC/DC dry alarm contact relay.

PART 3 - EXECUTION

3.1 EXAMINATION & PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application. Verify that systems to be insulated have been tested and are free of defects. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

- D. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.2 GENERAL APPLICATION REQUIREMENTS

- A. Provide insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout, including the length of ducts and fittings, valves, and specialties.
- B. Provide insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each system as specified in insulation system schedules.
- C. Provide accessories compatible with insulation materials and suitable for the service. Provide accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Provide insulation with longitudinal seams at top and bottom of horizontal pipe runs and equipment.
- E. Provide 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Provide insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Provide insulation over fittings, valves, and specialties, with continuous thermal and least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and specialties around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Provide insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PIPE AND DUCTWORK PENETRATIONS

- A. Insulation Installation at Roof or Aboveground Exterior Wall Penetrations: Install insulation continuously through penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof/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 roof/wall flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof/wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Penetrations:
 - 1. Fire Dampers: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

2. Pipe or duct penetrations (no fire damper): Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Division 7 for firestopping and fire-resistive joint sealers.

3.4 INSTALLATION OF PIPING INSULATION

- A. Metal shields shall be installed between hangers or supports and the piping insulation. Provide in accordance with Section 230529.
- 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.

- C. Insulate instrument connections for specialties (examples: thermometers, sensors, etc.) on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Locate seams in the least visible location.
- E. Insulation installed on piping operating below ambient temperatures must have a continuous vapor retarder. All joints, seams and fittings must be sealed. On systems operating above ambient, the butt joints should not be sealed.
- F. Flexible Elastomeric Insulation
 - 1. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 2. Insulation Installation on Pipe Flanges: Install pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. 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. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 3. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. 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.
 - 4. Insulation Installation on Valves and Pipe Specialties: Install preformed valve covers manufactured of same material as pipe insulation when available. 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. Install insulation to flanges as specified for flange insulation application. 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.
 - 5. After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating. Prior to applying the finish, the insulation shall be wiped clean with denatured alcohol. The finish shall not be tinted. To insure good adhesion, the temperature should be above 50 °F during application and drying. Outdoor exposed piping shall have the seams located on the lower half of the pipe.
 - 6. Outdoor exposed piping shall be painted with two coats of Armaflex WB Finish. Prior to applying the Finish, the insulation shall be wiped clean with denatured alcohol. The Finish shall not be tinted. Outdoor exposed piping shall have the seams located on the lower half of the pipe.

3.5 INSTALLATION OF DUCTWORK INSULATION

A. Flexible Fiberglass Blanket Insulation Installation:

1. Secure with adhesive and insulation pins.
2. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
3. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
4. Firmly butt all joints.
5. Where vapor retarder performance is required, all penetrations and damage to the facing shall be repaired using pressure-sensitive tape matching the facing, or mastic prior to system startup. Pressure-sensitive tapes shall be a minimum 3 inches wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool. Closure shall have a 25/50 Flame Spread/Smoke Developed Rating per UL 723. The longitudinal seam of the vapor retarder must be overlapped a minimum of 2 inches.
6. 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. Insulation shall be additionally secured to the bottom of rectangular ductwork over 24 inches wide using mechanical fasteners on 18-inch centers. Care should be exercised to avoid over-compression of the insulation during installation.
 - d. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - e. Do not over-compress insulation during installation. Install Duct Wrap using manufacturer's stretch-out tables to obtain specified R-value using a maximum compression of 25%.
 - f. Impale insulation over 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.
7. 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.
8. 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.
9. 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. 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.
 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.
- C. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 2. Install vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
- D. Fire-rated insulation system installation: Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating. Insulate duct access panels and doors to achieve same fire rating as duct.

3.6 INSTALLATION OF EQUIPMENT/ TANK INSULATION

A. Fiber Glass

1. Apply insulation to the equipment surface with joints firmly butted and as close as possible to the equipment surface. Insulation shall be secured as required with mechanical fasteners or banding material. Fasteners shall be located a maximum of 3" from each edge and spaced no greater than 12" on center.
2. For below ambient systems, vapor retarder jacketing shall overlap a minimum of 2" at all seams and be sealed with appropriate pressure-sensitive tape or mastic. All penetrations and facing damage shall be covered with a minimum 2" overlap of tape or mastic.

B. Flexible Elastomeric:

1. Install insulation over entire surface of tanks and vessels.
2. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
3. Seal longitudinal seams and end joints.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturers recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or other paintable jacket material: Paint jacket with paint system identified below and as specified in Division 9.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION APPLICATION SCHEDULE

- A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements. For piping systems not indicated, insulate to with a similar thickness and type as those specified.
- B. All cold surfaces that may “sweat” must be insulated. Vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. For above-ambient services, do not install insulation to the following: testing agency labels and stamps, nameplates, and cleanouts.
- D. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance. If piping type is omitted from list below, provide insulation per energy code or as per similar duty.
- E. Provide complete pipe PVC jackets in the following locations:
 - 1. For piping exposed in mechanical rooms within 6 feet above finished floor or high traffic areas.
 - 2. Exposed vertical piping in finished spaces.
- F. Domestic hot water: 1-1/4” and less: Glass Fiber, 1” thickness; 1-1/2 and larger: Glass Fiber, 1.5” thickness:
 - 1. Recirculating piping including the supply and return.
- G. Domestic cold water: Glass Fiber, 1/2” thickness.
- H. Rainwater conductors: Glass Fiber, 1” thickness. Provide for all horizontal piping and any vertical piping within 10 feet of the roof drain. Alternative: Roof drain bowls may be insulated with 2” of closed-cell spray-foam provided by Division 7. Coordinate with Division 7.
- I. Roof Drain Bodies: Flexible Elastomeric, 1/2” thickness.
- J. Rainwater conductors, heat traced: Glass Fiber, 2” thickness.
- K. AC pan drain or other cold drain piping: Flexible Elastomeric, 1/2” thickness. Or provide pre-insulated hose as specified in 238130.
- L. Refrigerant suction or hot gas piping: Flexible Elastomeric, 1.5” thickness.
- M. Ductless split: 1/2” Armaflex for liquid and gas piping. Coordinate with Section 238130, insulated line kits may be furnished.

- N. Radiant floor heating supply and return between 3-way control valve and radiant manifold: 105°F to 140°F:
1. Pipe size 1-1/4" and less: Glass Fiber; 1" thickness.
 2. Pipe size 1-1/2" and larger: Glass Fiber; 1-1/2" thickness.
 3. Insulation is not required for exposed piping through floor for convectors and radiators.
 4. Insulation is not required strainers, control valves, unions, and balancing valves associated with piping 1" or less diameter. Insulate piping to within approximately 1-inch of un-insulated items.
- O. Heating supply and return: 141°F to 200°F:
1. Pipe size 1-1/4" and less: Glass Fiber; 1-1/2" thickness.
 2. Pipe size 1-1/2" and larger: Glass Fiber; 2" thickness.
 3. Insulation is not required for exposed piping through floor for convectors and radiators.
 4. Insulation is not required strainers, control valves, unions, and balancing valves associated with piping 1" or less diameter. Insulate piping to within approximately 1-inch of un-insulated items.

3.11 EQUIPMENT INSULATION

- A. For equipment not indicated, insulate to with a similar thickness and type as those specified.
- B. Install insulation over entire surface of tanks and vessels. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive. Seal longitudinal seams and end joints.
- C. For Equipment insulation exposed in mechanical rooms or subject to mechanical abuse, finish with minimum 0.020 inch thick PVC jacketing or metal or laminated self-adhesive water and weather seals. All other insulation shall be finished as appropriate for the location and service or as specified on the drawings.
- D. 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.
- E. Omit insulation from the following, except for cold surfaces, which shall be provided with removable covers:
1. Hot water pumps
 2. Vibration-control devices.
 3. Testing agency labels and stamps.
 4. Nameplates and data plates.
 5. Manholes, hand holes, or cleanouts.
- F. Heating system expansion tank: same as hot water piping.
- G. Air separators, low loss headers, and similar equipment: same as hot water piping.
- H. Insulation materials and thicknesses are specified in schedules at the end of this Section. For duct systems not indicated, insulate to with a similar thickness and type as those specified.

- I. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance.

3.12 DUCT AND PLENUM APPLICATION SCHEDULE

A. Supply Ducts: Flexible Fiber Glass Blanket;

1. Ventilated Attic: R-6, 2" thickness.
2. Unvented Attic with Roof Insulation: R-6, 1.5" thickness.
3. Concealed or Unconditioned Space: R-6, 1.5" thickness.

B. ERU Ductwork

1. SA: After HW coil; None
2. SA: from unit to HW coil: Flexible Fiber Glass Blanket; R-8, 2" thickness.
3. RA: None

END OF SECTION 230700

SECTION 230900 – DIRECT DIGITAL CONTROL (DDC) SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, equipment, and service necessary for a complete and operating temperature controls system.
- B. There will not be a complete building automation system for this project. Stand alone DDC controllers are required to operate sequences, such as for ERUs only, other equipment sequences will be controlled thru manufacturer supplied equipment or electric controllers such as thermostats or sensors. Stand-alone controllers shall have display screen to view programming.
- C. Related Sections include the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 2. Division 23 Section “Common Work Results for Mechanical”
 - 3. Division 23 Sections with controller interfaces shall be integrated with the work of this Section.
 - 4. Division 23 Section “Testing, Adjusting, and Balancing”
 - 5. Division 26

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product include the following:
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
 - 3. Product description with complete technical data, performance curves, and product specification sheets.
 - 4. Installation, operation and maintenance instructions including factors effecting performance.
 - 5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
 - 6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
 - 7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Software Submittal:

1. Cross-referenced listing of software to be loaded on each DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.

C. Shop Drawings:

1. General Requirements:

- a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
- b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
- c. Prepare Drawings using CAD.

2. Schematic drawings for each controlled HVAC system indicating the following:

- a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
- b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
- c. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
- d. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
- e. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
- f. Narrative sequence of operation.

3. DDC system electrical power riser diagram indicating the following:

- a. Each point of connection to field power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
- b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
- c. Each product requiring power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
- d. Power wiring type and size, race type, and size for each.

4. Monitoring and control signal diagrams indicating the following:

- a. Control signal cable and wiring between controllers and I/O.
- b. Point-to-point schematic wiring diagrams for each product.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
 - 1. In addition to items specified in Division 1, include the following:
 - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
 - b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
 - c. As-built versions of submittal Product Data.
 - d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
 - e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
 - f. Licenses, guarantees, and warranty documents.
 - g. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
 - h. Owner training materials.

1.4 QUALITY ASSURANCE

- A. All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the owner's representative in writing. Spare parts shall be available for at least five years after completion of this contract.
- B. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer. Use only employees who are qualified, skilled, experienced, manufacturer trained and familiar with the specific equipment, software and configurations to be provided for this Project.
- C. Provide a complete, neat and workmanlike installation.
- D. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- G. Comply with ASHRAE 135 for DDC system control components.
- H. The contractor shall protect all work and material from damage by his/her work or employees. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

1.5 CONTRACTOR QUALIFICATIONS

- A. Qualified Bidders: System shall be as manufactured, installed and serviced by:
 - 1. Schneider Electric I/A, (Maine Controls)
 - 2. Johnson Controls, Inc.
 - 3. Honeywell
 - 4. Siemens
 - 5. Approved bidders. Bids from other vendors, franchised dealers, manufacturer's representatives, or from contractors who are authorized to represent the above named manufacturers must be pre-approved.
- B. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- C. Longevity: The Facilities Management System contractor shall have a minimum of ten years experience installing, and servicing computerized Building Automation Systems (BAS). All subcontractors utilized by the BAS contractor shall have a minimum of five-year experience within their appropriate trades.

1.6 COORDINATION

- A. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition.
- B. Coordinate details of telephone line, internet service provider, and associated requirements.
- C. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- D. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the controls system specified in this section. These controls shall be integrated into the system and coordinated by the contractor.

- E. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.
- F. Sheet Metal Subcontractor:
1. Installation of duct-mounted control devices.
 2. Access doors where indicated and as required for proper servicing.
- G. HVAC Contractor:
1. Installation of immersion wells and sockets, along with associated shut-off cocks.
 2. Installation of pipe-mounted control devices.
- H. Testing and Balancing Contractor:
1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
 2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
 3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
 4. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.
- I. Electrical Subcontractor: Complying with the principle of "unit responsibility" all electrical work for automatic controls, except as otherwise specified, or shown on the electrical drawings shall be included in Division 23. Electrical work shall, in general, comply with the following, unless otherwise directed by Division 26:
1. Power wiring.
 2. All control wiring shown on electric plans such as unit heater line-voltage room thermostats.
 3. Duct smoke detectors required for air handler shutdown are supplied under Division 26. Coordinate required length of sampling tube, for full span of ductwork. The contractor shall connect the DDC system to the auxiliary contacts provided on the smoke detector for system safeties and to provide alarms to the DDC system.
 4. All electrical work shall comply with the N.E.C. and local electrical codes.
 5. All safety devices shall be wired through both hand and auto positions of motor starting device to insure 100% safety shut-off.
 6. The motor starter supplier shall provide auxiliary contacts as required for interlock by BAS Contractor; the supplier shall estimate an allowance of at least one auxiliary contact per starter.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

1.8 WARRANTY

- A. Refer to Division 1 Requirements.

PART 2 - PRODUCTS

2.1 STAND ALONE DDC COMPONENTS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 - 4. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
 - 5. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.2 SENSING DEVICES

- A. Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.
- B. Thermistors: Precision thermistors may be used in applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degree F cumulative. A/D conversion resolution error shall be kept to 0.1 degree F. Total error for a thermistor circuit shall not exceed 0.5 degree F.
- C. Resistance Temperature Detectors (RTDs): Provide RTD sensors with platinum elements compatible with the digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel,

anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degree F cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25 degrees F. The total error for a RTD circuit shall not exceed 0.5 degree F.

D. Temperature Sensor Details

1. Room Type: Provide the sensing element components within a decorative protective cover suitable for surrounding decor.
 - a. Provide room temperature sensors with:
 - 1) Setpoint adjustment lever or knob.
 - 2) Digital temperature display.
 - 3) Insulating Bases: For temperature sensors/thermostats located on exterior walls.
2. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.
3. Pipe Immersion Type: Provide minimum three-inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel when used in steel piping, and brass when used in copper piping. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior.
4. Outside Air Type: Provide the sensing element on the building's north side with a protective weather shade that positions the sensor approximately 3 inches off the wall surface, does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain.

E. Transmitters: Provide transmitters with 4 to 20 mA or 0 to 10 VDC linear output scaled to the sensed input. Transmitters shall be matched to the respective sensor, factory calibrated, and sealed. Size transmitters for an output near 50 percent of its full-scale range at normal operating conditions. The total transmitter error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 12 to 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter drift shall not exceed 0.03 degrees F a year.

F. Current Transducers: Provide current transducers to monitor motor amperage, unless current switches are shown on design drawings or point tables.

G. Input Switches

1. Timed Local Overrides: Provide buttons or switches to override the DDC occupancy schedule programming for each major building zone during unoccupied periods, and to return HVAC equipment to the occupied mode. This requirement is waived for zones clearly intended for 24 hour continuous operation.
2. Freeze Protection Thermostats: Provide special purpose thermostats with flexible capillary elements 20 feet minimum length for coil face areas up to 40 square feet. Provide longer elements for larger coils at 1-foot of element for every 4 square feet of

coil face area, or provide additional thermostats. Provide switch contacts rated for the respective motor starter's control circuit voltage. Include auxiliary contacts for the switch's status condition. A freezing condition at any 18-inch increment along the sensing element's length shall activate the switch. The thermostat shall be equipped with a manual push-button reset switch so that when tripped, the thermostat requires manual resetting before the HVAC equipment can restart.

H. Gas Detection

1. Natural Gas (Ch4), Monitor / Transmitter; Kele Model GDS gas monitor/transmitter or equal. Microprocessor-based system for continuous effective monitoring of *combustible* gases. Provide 4-20 mA output in proportion with DPDT alarm contacts; Gas concentration display: 10-step progressive LED; Visual Indicators shall be Green light "normal operation"; Provide audible alarm: 65 dbA at 3 ft; Catalytic combustion S1-type sensor; UL listed; 2 year warranty
 - a. Detection range: 0-100% L.E.L. (Lower Explosive Limit)
 - b. Accuracy 3%
 - c. Alarm set point: 1.25% Methane by volume (25% L.E.L).

2.3 THERMOSTATS

- A. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.4 OUTPUT HARDWARE

- A. Elevator shaft motorized heat/smoke relief damper shall be as follows:
 1. Submittals shall include leakage, maximum airflow and maximum pressure ratings based on AMCA Publication 500. Dampers shall meet the leakage requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and shall be AMCA licensed as Class 1A. Damper shall be GRENHECK model VCD-34 (insulated), or approved equal.
 2. Low leakage double skin blade filled with ½" fiberglass insulation.
 3. Frame: 5 inches x minimum 16 gage roll formed, galvanized steel hat-shaped channel, reinforced at corners. Blades shall be not less than 16-gauge.
 4. Bearings shall be corrosion resistant, permanently lubricated stainless steel sleeve type turning in an extruded hole in the damper frame.
 5. All blade edges, top, and bottom of the frame shall be provided with replaceable TPE seals.
 6. Dampers shall have exposed linkages. Dampers over 48" in applications where sectioning is not applicable shall be supplied with a jackshaft to provide sufficient force throughout the intended operating range.

- B. Electronic damper/valve actuation shall be provided.
1. Manufactured, brand labeled or distributed by BELIMO, or approved equal.
 2. Size for torque required for damper seal at load conditions.
 3. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
 4. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
 5. Overload protected electronically throughout rotation.
 6. Actuator shall SPRING OPEN upon activation of local area smoke detector.
 7. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
 8. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10 VDC position feedback signal.
 9. Temperature Rating: -22 to +122°F -30 to +50°C [-58 to +122°F -50 to +50°C]
 10. Housing: Minimum requirement NEMA type 2 mounted in any orientation. .
 11. Agency Listings: ISO 9001, cULus, CE or CSA
 12. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.
- C. Control Valves: Control valves shall be two-way or three-way type for two-position or modulating service as shown.
1. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Two-way: 150% of total system (pump) head.
 - b. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 2. Water Valves: Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
 - a. Sizing Criteria:
 - 1) Two-position service: Line size.
 - 2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, which ever is greater.
 - 3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 5 psi maximum.

- b. Application:
 - 1) Duct coils: two-way floating control, non spring return.
 - 2) CUH and Convectors: two-way two position, spring open 100%.
 - 3) Radiant manifolds: three-way floating control, non spring return.
 - c. Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
 - d. Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
 - e. Water valves shall fail normally open or closed, as specified.
- D. Output Switches: Control Relays; Field installed and DDC panel relays shall be double pole, double throw, UL864 listed, with contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light shall be lit when the coil is energized and off when coil is not energized. Relays shall be the socket type, plug into a fixed base, and replaceable without tools or removing wiring. Encapsulated "PAM" type relays may be used for terminal control applications.

2.5 ELECTRICAL POWER AND DISTRIBUTION

- A. Transformers: Transformers shall conform to UL 506. For control power other than terminal level equipment, provide a fuse or circuit breaker on the secondary side of each transformer.
- B. Surge and Transient Protection
 - 1. Provide each digital controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.
 - 2. Power Line Surge Protection: Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following:
 - a. The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.
 - b. The device shall react within 5 nanoseconds and automatically reset.
 - c. The voltage protection threshold, line to neutral, shall be no more than 211 volts.
 - d. The device shall have an independent secondary stage equal to or greater than the primary stage joule rating.
 - e. The primary suppression system components shall be pure silicon avalanche diodes.
 - f. The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.
 - g. The device shall have an indication light to indicate the protection components are functioning.
 - h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.

- i. The device shall have an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.
 - j. The device shall comply with IEEE C62.41.1 and IEEE C62.41.2, Class "B" requirements and be tested according to IEEE C62.45.
 - k. The device shall be capable of operating between -20 degrees F and 122 degrees F.
3. Telephone and Communication Line Surge Protection: Provide surge and transient protection for DDC controllers and DDC network related devices connected to phone and network communication lines. The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges. The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology. The device shall be installed at the distance recommended by its manufacturer.
 4. Controller Input/Output Protection: Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.
- C. Wiring: Provide complete electrical wiring for the DDC System, coordinate line of demarcation with Division 26. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring in conduit. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Division 26. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, attics, or above suspended ceilings.
- D. Power Wiring: The following requirements are for field-installed wiring:
1. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.
 2. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.
- E. Analog Signal Wiring: Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before

rough-in work is started. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

- A. Provide software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation. Connect and configure equipment and software to achieve sequence of operation specified.
- B. Provide all components in accordance with the manufacturer's recommendations. Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.
- C. Provide equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- D. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.
- F. Temperature Sensors: Provide temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.
- G. Room Temperature Sensors: Verify location of thermostats and other exposed control sensors with plans and room details before installation. Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of the sensor 48 inches above the floor to meet ADA requirements.
- H. Duct Temperature Sensors
 - 1. Probe Type: Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. Seal the duct insulation penetration vapor tight.
 - 2. Hot water coil freeze protection thermostats: Weave the capillary tube sensing element in a serpentine fashion perpendicular to the flow, across the hot water coil. Provide a duct access door at the thermostat location. The access door shall be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit; maximum 18 x 18 inches. For sensors inside air handlers, the sensors shall be fully accessible through the air handler's access doors without removing any of the air handler's internals.
- I. Outside Air Temperature Sensors: Provide outside air temperature sensors in weatherproof enclosures on the north side of the building, away from exhaust hoods and other areas that may affect the reading. Provide a shield to shade the sensor from direct sunlight.

- J. Gas Monitor/Transmitters: Verify location of transmitter with room layout and details before installation. Do not exceed the manufactures' recommended maximum surveillance radius. Provide proper quantity as required. Mounting height shall be at manufacturer recommended height for the gas being sensed.
- K. Provide automatic dampers according to Section 233113 "Ductwork."
- L. Provide damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- M. Provide labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- N. Provide hydronic instrument wells, valves, and other accessories according to Section 232116 "Hydronic Piping Specialties." Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermal conductivity material within the well to fully coat the inserted sensor.
- O. Provide refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."
- P. Provide duct volume-control dampers according to Section 233113 "Ductwork"

3.3 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification. Where the requirements of this section differ from Division 26, the requirements of this section shall take precedence.
- B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements. Low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.
- C. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.
- D. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- E. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 10 ft intervals.

- F. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- G. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- H. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- I. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- J. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- K. Conceal all raceways except within mechanical, electrical, or service rooms.
- L. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- M. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- B. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instrument tubing for proper fittings, slope, material, and support.
 - 3. Check installation of air supply for each instrument.
 - 4. Check temperature instruments and material and length of sensing elements.

5. Check control valves. Verify that they are in correct direction.
6. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 DEMONSTRATION

- A. Provide a qualified instructor (or instructors) with five years minimum field experience with the installation and programming of similar BACnet DDC systems. Orient training to the specific systems installed. Coordinate training times with the Owner. Training shall take place at the job site.
- B. This training shall last 8 hours and shall be conducted at the DDC system workstation, at a notebook computer connected to the DDC system in the field, and at other site locations as necessary. Upon completion of the Training, each trainee should fully understand the project's DDC system operation.
- C. Provide basic control system fundamentals training.
 1. This project's list of control system components
 2. This project's list of points and objects
 3. This project's sequences of control, and:
 4. Alarm capabilities

3.6 TEST AND BALANCE SUPPORT

- A. The controls contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel This support shall include:
 1. On-site operation and manipulation of control systems during the testing and balancing.
 2. Control setpoint adjustments for balancing all relevant mechanical systems.
 3. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.7 CONTROLS SYSTEM OPERATORS MANUALS

- A. Provide three electronic and printed copies of a Controls System Operators Manual. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.

- B. Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types. When approved by the Owner, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders.

3.8 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be required to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for Mechanical"
 - 2. Section 230900 – Instrumentation and Control for HVAC for control equipment and devices and submittal requirements.
 - 3. Division 23 Sections – Equipment with built in DDC controllers
 - 4. Division 23 Section "Testing, Adjusting, and Balancing"
 - 5. Division 26

1.2 GENERAL

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment. Provide control devices, control software and control wiring as required for automatic operation of each sequence specified. The system is BAS controlled using electric actuation.
 - 1. Provide automatic control for system operation as described herein, although word "automatic" or "automatically", is not used.
 - 2. Manual operation is limited only where specifically described; however, provide manual override for each automatic operation.
 - 3. Where manual start-up is called for, also provide scheduled automatic start-stop capabilities.
- B. These sequences are intended to be performance based. Implementations that provide the same functional result using different underlying detailed logic will be acceptable.
- C. Functions called for in sequence of operations are minimum requirements and not to limit additional BAS system capabilities. Determine, through operation of the system, proportional bands, interval time, integral periods, adjustment rates, and any other input information required to provide stable operation of the control programs.
- D. Variable Frequency Drives (Manufacturer provides with HVAC equipment)

- E. Normal positions for controlled devices:
1. Unless noted, the following valves and dampers shall fail closed:
 - a. Outside air dampers
 - b. Relief air dampers
 - c. Exhaust air closure dampers
 - d. Domestic hot water heat source.
 2. Unless noted, the following valves and dampers shall fail open:
 - a. Heating coils.

PART 2 - HEATING PLANT

2.1 COMBINATON DHW BOILER & HYDRONIC HEATING UNIT (See Section 223400).

- A. Upon a call for heat, the Combination Heating Plant Controller shall turn on the main heating pump based on OA temperature. (controller provided under Section 223400).
1. When OA is below 60F (adj) enable main heating pump.
 2. Heating-Water Supply Temperature Reset: When OA is 60 F - HWS is 120 F; When OA is 30 F - HWS is 150 F (adj).
 3. Input: Outside air temperature sensor wired to controller
 4. Input: Provide heating main supply and main return temperature sensors.
- B. DHW Temperature adjusted thru the Combination Heating Plant Controller.
1. TMV specified in Section 22 11 19 will mix the tank water with cold water to provide 120°F to the building.
 2. DHW recirculation pump operates via pipeline aquastat.
- C. Combustion air: Direct piped; combustion air damper control not required.

PART 3 - HVAC DISTRIBUTION

3.1 ENERGY RECOVERY UNITS

- A. Simple ERU
1. Occupied mode:
 - a. Normally closed outside air and exhaust dampers shall be open.
 - b. Supply and Exhaust fans operate continuously during occupied hours, subject to damper end switches.

- c. Duct heating coil operation: 2-way heating coil control valve shall modulate to maintain a neutral supply air temperature of 65°F (adj.).
2. Duct Heating Coils, Hydronic:
 - a. Room Temperature:
 - 1) Input Device: Electronic temperature sensor.
 - 2) Output Device: Two way control valves with 0-10VDC modulating actuators
 - 3) Action: Modulate to maintain a neutral supply air temperature of 70 °F (adj.)
 3. Unoccupied Mode: Unit fans shall be off & dampers closed 100%, And coil closed 100%.
 4. Safety:
 - a. Freezestat: Shuts down ERU, closes dampers 100%, opens heating control valve 100%.

3.2 RADIANT SLAB HEATING

- A. Floor Slab Warming/Tempering (one system for 1st floor and one system for 2nd floor): The intent of this system is not to heat the 1st and 2nd floors but to maintain the floor slab at a “neutral” warm temperature to prevent occupants from having a cold floor. This system operates independently from the multi-split heat pump system during heating season.
 1. The controller (equal to Tekmar) shall operate pump on/off based on OA and modulate 3-way valve based on slab temperature.
 2. Input Device: Provide (1) slab temperature sensor for each manifold; sensor shall be installed in conduit centered in the floor.
 3. Input Device: Manifold heating hot water supply and return temperature sensors.
 4. Output Devices: modulating HW 3-way control valve and pump.
 5. Action:
 - a. The slab temperature sensor measures the floor temperature. When OA temp is below 50°F, Controller shall start respective manifolds’ pumps and modulate respective 3-way control valve as required to maintain 68°F (adj.) slab temperature.
 - b. Controller shall stop respective manifolds’ pumps when OA temperature is 50°F (adj.) or higher.

PART 4 - PLUMBING SEQUENCES

- 4.1 Domestic Hot Water Recirculation Pumps: Operate the pumps only when the DHW temperature in the return line near the DHW heater falls below 115°F. Pump cycling shall be controlled by a return line aquastat set at 115°F with a 5°F deadband.

PART 5 - MISCELLANEOUS SEQUENCES

5.1 DUCTLESS SPLIT HEAT PUMP SYSTEM

- A. AC unit shall operate by manufacturer-supplied controls and wall thermostat to maintain setpoint during occupied and unoccupied modes.
- B. Refer to drawings and heat pump specifications where 3rd party wall thermostats are required to interface with heat pump system controls.

5.2 TERMINAL UNITS

- A. Hydronic Unit Heater: Space thermostat cycles fan, after strap on aqua-stat reaches 130 F, to maintain room setpoint (70 F adj.)

5.3 GAS DETECTION

- A. Natural Gas (CH₄) Alarm
 - 1. Alarm if limit reaches maximum setpoint for the following spaces:
 - a. Boiler Room

END OF SECTION 230993

SECTION 231123 – FACILITY FUEL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 2 Sections.
 - 2. Division 7 Section for fire stopping.
 - 3. Division 23 Section "Common Work Results for HVAC"
 - 4. Division 23 Section "Hangers and Supports"

1.2 SUMMARY

- A. This Section includes fuel gas piping, specialties, and accessories within the building.

1.3 PROJECT CONDITIONS

- A. Natural Gas System Pressure: Coordinate with gas supplier.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Corrugated, stainless-steel tubing systems. Include associated components.
 - 2. Specialty valves
 - 3. Pressure regulators.
 - 4. Meters
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Maintenance Data: For natural gas specialties and accessories to include in maintenance manuals specified in Division 1.
- D. Seismic Delegated-Design Submittal:
 - 1. For piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- a. Determine seismic restraint sizes and locations.
 - b. Provide seismic restraints as scheduled or specified.
 - c. Provide calculations and materials if required for restraint of un-isolated equipment.
 - d. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.
2. Seismic restraints shall be designed in accordance with seismic force levels as detailed herein. Seismic-Restraint Loading:
- a. Seismic-Restraint Loading: Refer to Structural Drawing S000, A1.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.6 QUALITY ASSURANCE

- A. All work shall be performed by fuel gas licensed technicians.
- B. Installations of fuel gas must also comply with all other applicable statutes or rules of the State and all applicable ordinances, orders, rules, and regulations of local municipalities.
- C. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. All work shall be per the following codes. Year edition of code shall be as recognized by the authority with jurisdiction
 - 1. NFPA 54 "National Fuel Gas Code".
 - 2. Maine Fuel Board Rules
- E. FM Standard: Provide components listed in FM's "Fire Protection Approval Guide" if specified to be FM approved.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.

1.8 COORDINATION

- A. Natural Gas: Make arrangements with local utility for gas service to the Owner's distribution system. Provide service to the building as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the gas service shall comply with the published Utility Company standards. Pay all utility company charges; include charges in the base bid.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Corrugated, Stainless-Steel Tubing Systems:
 - a. Omega Flex, Inc.
 - b. Titeflex Corp.
 - c. Tru-Flex Metal Hose Corp.
 - d. Ward Manufacturing, Inc.
 2. Valves:
 - a. American Valve.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Crane Valves.
 - d. Grinnell Corp.
 - e. Honeywell, Inc.
 - f. McDonald: A. Y. McDonald Mfg. Co.
 - g. Milwaukee Valve Co., Inc.
 - h. Nibco, Inc.
 - i. Mueller Co.; Mueller Gas Products Div.
 - j. Watts Industries, Inc.
 3. Pressure Regulators:
 - a. American Meter Co.
 - b. Equimeter, Inc.
 - c. Fisher Controls International, Inc.
 - d. Maxitrol Co.
 - e. National Meter.
 - f. Richards Industries, Inc.; Jordan Valve Div.
 - g. Schlumberger Industries; Gas Div.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

- A. Steel Pipe: ASTM A 106, Grade B; Schedule 40; black.
1. Malleable-Iron Threaded Fittings: ASME B16.1, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
 3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
 4. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
 5. Joint Compound and Tape: Suitable for natural gas.
 6. Steel Flanges and Flanged Fittings: ASME B16.5.
 7. Gasket Material: Thickness, material, and type suitable for natural gas.
- B. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
- C. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.

2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency. Flame-Spread Index: 25 or less. Smoke-Developed Index: 50 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

- D. Transition Fittings: Type, material, and end connections to match piping being joined.
- E. Common Joining Materials: Refer to Division 23 Section "Common Work Results for HVAC" for joining materials not in this Section.

2.4 SPECIALTY VALVES

- A. Valves, NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
- B. Appliance Connector Valves: ANSI Z21.15 and IAS listed.
- C. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.
- D. Gas Valves, NPS 2 and Smaller: ASME B16.33 and IAS-listed bronze body and 125-psig pressure rating. Tamperproof Feature: Include design for locking.

2.5 NATURAL GAS SERVICE METER AND PRESSURE REGULATOR

- A. Natural Gas Service Meter: Provided by gas supplier. Coordinate requirements and pay all fees.

2.6 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 4. Corrugated stainless-steel tubing with polymer coating.
 5. Operating-Pressure Rating: 0.5 psig.
 6. End Fittings: Zinc-coated steel.

7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

- C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.7 PRESSURE REGULATORS

- A. Provide service, line, and appliance pressure regulators as indicated and as required by code. Regulators may include vent limiting device, instead of vent connection to outside, if approved by authorities having jurisdiction. Provide venting as required by code.
- B. Line Pressure Regulators: ANSI Z21.80 with 10-psig inlet pressure rating, unless otherwise indicated.
- C. Appliance Pressure Regulators: ANSI Z21.18.
- D. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

2.8 SEISMIC RESTRAINTS

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.
- C. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint.

- D. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required.
- E. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt.

2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off fuel gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 NATURAL GAS SERVICE ENTRANCE PIPING

- A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.
- B. Provide dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Provide shutoff valve downstream from and adjacent to dielectric fitting.

3.4 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Fuel Gas Piping: Use the following:
 - 1. NPS 1 and Smaller: steel pipe, malleable-iron threaded fittings, and threaded joints. Option: Corrugated, stainless-steel tubing may be used for runouts at individual appliances.
 - 2. NPS 1-1/4 to NPS 2: Steel pipe, malleable-iron threaded fittings, and threaded joints.
- C. In-slab (within building) Fuel Gas Piping: Not permitted.
- D. Commercial Cooking Appliances. Commercial cooking appliances shall be connected in accordance with the connector manufacturer's installation instructions using a listed appliance connector complying with ANSI Z21.69, Connectors for Moveable Gas Appliances.
- E. Gas Service Piping at Meters and Regulators: Steel pipe, steel welding fittings, and welded joints.

3.5 VALVE APPLICATIONS

- A. Appliance Shutoff Valves for Pressure 0.5 to 2 psig: Gas stop or gas valve.
- B. Piping Line Valves, NPS 2 and Smaller: Gas valve.
- C. Valves at Service Meter, NPS 2 and Smaller: Gas valve.

3.6 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for HVAC" for basic piping installation requirements.
- B. All work must be conducted, installed, and completed in a neat and professional manner reflecting a minimum level of competent workmanship.
- C. Drips and Sediment Traps: Provide drips at points where condensate may collect. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Provide with space between bottom of drip and floor for removal of plug or cap.
- D. Provide fuel gas piping at uniform grade of 1/4" per 15 feet.
- E. Use eccentric reducer fittings to make reductions in pipe sizes. Provide fittings with level side down.

- F. Connect branch piping from top or side of horizontal piping.
- G. Provide unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- H. Provide corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- I. Provide strainer on inlet of each line pressure regulator.
- J. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- K. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.
- L. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.
 - 1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
 - 2. In Floors: Not permitted.
 - 3. In Partitions: Do not install concealed piping in solid partitions. Tubing may be installed if protected with striker barriers per NFPA 54.
 - 4. In Walls: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in masonry walls, subject to approval of authorities having jurisdiction.
 - 5. Prohibited Locations: Do not install gas piping where not allowed by NFPA.

3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports."

B. Provide seismic restraints on piping.

C. Provide hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 6 feet; minimum rod size, 3/8 inch.
2. NPS 3/4 or NPS 1: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4 to 2": Maximum span, 10 feet; minimum rod size, 3/8 inch.

D. Corrugated stainless steel piping shall be supported per manufacturer's recommendations.

E. Support horizontal corrugated, stainless-steel tubing from structure according to manufacturer's written instructions.

3.9 SEISMIC RESTRAINT OF PIPING

A. Seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

B. Installation of seismic restraints must not cause any change of position of equipment or piping resulting in stresses or misalignment.

C. Coordinate work with other trades to avoid rigid contact with the building.

D. Overstressing of the building structure must not occur because of overhead support of equipment. Generally bracing may occur from:

1. Flanges of structural beams.
 2. Upper truss cords in bar joist construction.
 3. Cast in place inserts or wedge type drill-in concrete anchors.
- E. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, piping or conduit. Cable assemblies shall be installed taut on non-isolated systems. Seismic solid braces may be used in place of cables on rigidly attached systems only.
1. The support rods must be braced when necessary to accept compressive loads with steel angles and rod clamp assemblies.
 2. At all locations where restraints are attached to pipe clevis's, the clevis cross bolt must be reinforced with pipe clevis cross bolt braces.
 3. Seismically restrain the following piping: Fuel gas piping that is 1" I.D. or larger.
 4. Piping exclusions:
 - a. Gas piping less than 1" inside diameter.
 - b. All piping suspended by individual hangers 12" or less as measured from the top of the pipe to the bottom of the support where the hanger is attached. However, if the 12" limit is exceeded by any hanger in the run, seismic bracing is required for the run.
 - c. The 12" exemption applies for trapeze-supported systems if the top of each item supported by the trapeze qualifies.
 5. Transverse piping restraints shall be at 20' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 6. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 7. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or tee or combined stresses are within allowable limits at longer distances.
 8. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
 9. Branch lines may not be used to restrain main lines.
- F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

3.10 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Provide piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Provide valve upstream from and within 72 inches of each appliance. Provide union downstream from valve.
- D. Sediment Traps: Provide tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

3.11 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Provide engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.
 - 1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 - 2. Refer to Division 23 Section "Identification for HVAC" for nameplates and signs.

3.12 PAINTING

- A. Comply with requirements in Division 9 for painting interior and exterior Natural Gas piping.
- B. Paint all exterior metal piping, valves, regulators, service meters and meter bars, and piping specialties, except components with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel
 - d. Color: As selected by Architect
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.13 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to NFPA 54/58 chapter: "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.
- G. Verify that the gas piping has been grounded by Division 16 in accordance with NFPA requirements.

3.14 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 231123

SECTION 232113 – HYDRONIC HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 7 Section for materials and methods for sealing pipe penetrations.
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Hangers and Supports" for pipe supports.
 - 4. Division 23 Section "Thermometers and Pressure Gages"
 - 5. Division 23 Section "Mechanical Identification" for labeling and identifying.
 - 6. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories.
 - 7. Division 23 controls section for temperature-control valves and sensors.

1.2 SUMMARY

- A. This Section includes piping and specialties for hydronic HVAC piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping
 - 2. Hydronic specialties
 - 3. Chemical treatment.
- B. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Qualify soldering processes, procedures, and solderers for copper and copper alloy pipe and tube in accordance with ASTM B 828.
- C. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- E. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

1.7 COORDINATION

- A. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- B. Coordinate layout and installation of hydronic piping and suspension system components with other construction.
- C. Coordinate pipe sleeve installations and penetrations with other trades.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Victaulic Company of America.
 - b. Anvil
 - c. Grinnell Corporation.

2. Balancing Valves:
 - a. Griswold Controls.
 - b. ITT Bell & Gossett
 - c. Taco, Inc.
 - d. Tour & Anderson
 - e. Flow Design, Inc.
 - f. Griswold Controls
 - g. Watts Industries Inc.
 - h. Caleffi
 - i. Nexus

3. Hydronic Pressure-Reducing Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT Bell & Gossett
 - e. Spence Engineering Company, Inc.
 - f. Caleffi
 - g. Watts Industries, Inc.

4. Safety Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT McDonnell & Miller.
 - e. Kunkle Valve Division.
 - f. Spence Engineering Company, Inc.
 - g. Caleffi
 - h. Watts Industries Inc.

5. Expansion Tanks, Air Separators, and Hydronic Specialties:
 - a. Amtrol, Inc.
 - b. Woods
 - c. ITT Bell & Gossett
 - d. Taco, Inc.
 - e. Caleffi
 - f. Watts Industries Inc.
 - g. Wessels

- h. Patterson
- i. Thrush

6. Air Vents and Vacuum Breakers:

- a. Armstrong International, Inc.
- b. Barnes & Jones, Inc.
- c. ITT Hoffman
- d. Caleffi
- e. Spirax Sarco, Inc.

2.2 PIPING MATERIALS

- A. General: **Refer to Part 3** "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A-53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 and larger: ASTM A-53, Type E (electric-resistance welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A-234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings: Material Group: 1.1. End Connections: Butt-welding. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Victaulic or approved equal.
2. Standard Grooved 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 forged steel fittings with grooves or shoulders constructed to accept Victaulic grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Standard Couplings: Ductile-iron housing and synthetic rubber gasket of central cavity pressure-responsive design (Grade "E" EPDM for water services -30°F to 230°F or Grade "EHP" EPDM for water services rated -30°F to 250°F); with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9; Victaulic Style 07 (Zero-Flex®) or Style 107 Quick-Vic® Installation-Ready design.
 - b. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 75 or 77.
 - c. Flange Adapters: Ductile iron housing, flat face, for use with grooved end pipe and fittings, for mating directly with ANSI Class 125, 150, and 300 flanges. Victaulic Style 741 or 743.

I. Mechanically formed copper or steel tee connections are **not acceptable**.

J. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ANSI B16.11 may be used for drain, vent and gage connections.

K. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

L. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 PEX PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. PEX-a manufacturer system warranty shall cover tubing for a duration of 30 years from the date of installation.

1. Uponor Wirsbo hePEX (Basis of Design)

2. Rehau
 3. Watts Radiant
 4. Viega
- B. PEX-a (Engle-method Crosslinked Polyethylene) Piping: ASTM 876 with oxygen-diffusion barrier that meets DIN 4726. Performance Requirements: 200°F at 80 psi, 180°F at 100 psi. Provide fittings from the same manufacturer of the piping.
- C. PEX-a Fittings, Elbows and Tees (½ inch through 2 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
1. UNS No. C69300 Lead-free (LF) Brass
 2. 20% glass-filled polysulfone as specified in ASTM D6394
 3. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D6394
 4. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D6394
 5. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D6394
 6. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".
- D. PEX-a Fittings (2½ inch through 4 inch nominal pipe size): SDR9 compression type fitting consisting of a double O-ring insert with a compression sleeve tightened around the pipe and insert.
- E. Plastic-to-Metal Transition Fittings: 2" and below: Threaded Brass to PEX-a Transition: one-piece brass fitting with male or female threaded adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Brass Sweat to PEX-a Transition: one-piece brass fitting with sweat adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. 2-1/2" and larger: Dezincification-resistant (DZR) Brass to PEX-a Transition: male NPT thread and PEX compression fitting.
- F. Plastic-to-Metal Transition Unions: Threaded Brass to PEX-a Union: one-piece brass fitting with male or female threaded adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

2.6 HYDRONIC VALVES

- A. Gate Valves
1. Threaded Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising-stem, solid wedge: Hammond IB617, Nibco T-124/134, Stockham B105, Milwaukee 1152 or equal.
 2. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge: Hammond IR1140, Nibco F617-0, Stockham G623, Milwaukee F2885 or equal.
 3. Solder Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising-stem, solid wedge: Hammond IB648, Nibco S134, Stockham B115, Milwaukee 1169 or equal.
 4. Comply with the following standards: Cast Iron Valves: MSS SP – 70; Bronze Valves: MSS SP – 80.

B. Ball Valves

1. Threaded Ends 4" and Smaller: 150 psi WP and 600psi non-shock CWP, forged brass full-port or cast bronze two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Watts FBV-3C series/B6080 series, Hammond 8501, Nibco T-585-70, Milwaukee BA100, Apollo 70-Series, or approved equal.
2. Soldered Ends 3" and Smaller: 150 psi WP and 600psi non-shock CWP, full-port cast bronze or forged brass two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Watts FBVS-3C series/B6081 series, Hammond 8511, Nibco S-585-70, Milwaukee BA150, Apollo 70-Series, approved or equal.
3. Comply with MSS SP-110.

C. Swing check valves:

1. Construct pressure containing parts of Valves as follows: Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62; Iron Body Valves: ANSI/ASTM A-126, Grade B. Comply with the following standards for design, workmanship, material and testing: Bronze Valves: MSS SP – 80; Cast Iron Valves: MSS SP – 71.
2. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
3. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB904, Nibco T-413Y, Stockham B320T, Milwaukee 509 or approved equal.
4. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB912, Nibco S-413-Y, Stockham B310T, Milwaukee 511 or approved equal.
5. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Hammond IR1124, Nibco F918-B, Stockham G931, Milwaukee F2974 or approved equal.

D. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and non-corrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

E. ASME Safety Relief Valves: Bell & Gossett A-434D, or equal; diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV. The fluid shall not discharge into the spring chamber. The valve shall have a low blow-down differential. The valve seat and all moving parts exposed to the fluid shall be of non-ferrous material.

2.7 HOOKUPS AND BALANCING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Nexus (Basis of Design)
2. Flow Design

3. Hays
4. Griswold
5. Victaulic
6. Taco
7. Bell & Gossett

B. Minimum Requirements Per Coil Installation:

1. Automatic Flow Control Valve (AFCV) or Manual Flow Control Valve (MFCV) as indicated.
2. Y-strainer.
3. Temperature Control Valve (TCV) – see 230900.
4. Union connections at coil and TCV.
5. Air vent on return side.
6. Blowdown/drain valve on supply side.
7. Pressure/temperature test plugs across coil and TCV.
8. Full port, union end ball valves or butterfly valve for shutoff.

C. Materials Of Construction (2½” and smaller, except as noted)

1. Brass or stainless steel metals.
2. Teflon, EPDM or FKM seals.

D. Installation

1. Installation shall conform to basic piping methods specifications.
2. All components shall be isolated by shutoff valves.
3. Flexible hoses shall be installed at coil connections as shown in the plans or at the option of the mechanical contractor.
4. Union tailpieces may be used to reduce pipe sizes to match coil and TCV valve sizes.
5. Pressure/Temperature test plugs shall be installed across coil.
6. A Y-strainer or combination strainer and valve shall be installed on the supply side.
7. Unions shall be used to isolate the coil, AFCV and TCV.

E. Shutoff Valves (2½” and smaller) shall be forged brass ball valves, Nexus Model UX:

1. A one-piece body rated at 600 psi WP, 325° F.
2. Interchangeable union ends with FKM O-ring seal (ground joint is not acceptable).
3. Multiple ¼” tapped ports for test plugs, vent, and/or drain.
4. Blowout-proof stem with dual KFM O-ring seals.
5. Hard chrome plated stainless steel ball with Teflon seats.

F. Automatic Flow Control Valves shall be non-clogging design, Nexus Model UM:

1. The flow cartridge’s non-clogging service design shall include no metal-to-metal contact, no segmented ports, and incorporate a flow nozzle and a metering disc controlled by a pressure compensating spring.

2. The flow cartridge shall be a single assembly, constructed with stainless steel moving parts and be accessible without removing the valve from the piping (½" thru 2½" brass valves).
 3. The flow cartridge shall be 100% factory flow tested and calibrated to maintain an accuracy of ±5%; the accuracy shall be 100% maintained over the operating pressure range.
 4. The flow cartridge shall carry a limited lifetime material warranty.
 5. Valves (2½" and smaller) shall be a forged brass Y-pattern body with ball valve, (2) pressure/temperature ports, a tag indicating the model, flow rate and PSID range, blowout proof stem with dual FKM O-ring seals, interchangeable union end with FKM O-ring seal, hard chrome plated brass ball with Teflon seats, and rated at 600 psi WP, 325° F.
- G. Manual Flow Control Valves (2½" and smaller) shall be a combination of metering/balance type of forged brass construction, Nexus Model XB:
1. A modified venturi equipped with (2) pressure/temperature ports and an ID tag.
 2. A combination shutoff and memory stop device-indicating degree of opening.
 3. A rating of 600 WOG, 325°F.
 4. An interchangeable union ends with FKM O-ring type seal.
 5. Blowout proof stem with dual FKM O-ring seals.
 6. Hard chrome plated stainless steel ball with Teflon seats.
- H. Temperature Control Valves, ref. Section 230900 & 230993.
- I. Combination Strainer/Ball Valves (2½" and smaller) used for supply side shutoff and strainer requirements shall be forged brass construction, Nexus Model UY:
1. A minimum rating of 600 WOG, 325° F.
 2. Interchangeable union end with FKM O-ring seal.
 3. Multiple ¼" tapped ports for test plugs, vent, or other accessories.
 4. Blowout proof stem with dual FKM O-ring seals.
 5. Hard chrome plated stainless steel ball with Teflon seats.
 6. A 20 mesh 304 stainless steel filter screen, accessible without affecting the valve piping.
 7. A port in the filter cap for a blowdown/drain valve.
- J. Y-Strainers (2½" and smaller) shall be forged brass body, Nexus Model UYX:
1. ¼" tapped accessory ports.
 2. A rating of 600 WOG, 325° F.
 3. A 20 mesh 304 stainless steel filter screen, removable without affecting the strainer piping.
 4. A port in the filter cap for a blowdown/drain valve.
- K. Blowdown/Drain Valves shall be forged brass ball valve construction, Nexus Model BD:
1. A minimum rating of 600 WOG, 325° F.
 2. Blowout proof stem with dual FKM O-ring seals.
 3. Hard chrome plated brass ball with Teflon seats.
 4. A ¾" hose end and nylon / brass cap with retainer to protect threads.

- L. Unions (2" and smaller) shall be forged brass, Nexus Model UU:
1. A minimum of 600 psi WP, 325° F.
 2. Multiple ¼" tapped ports for test plugs, vent and/or drain valves.
 3. FKM O-ring seal.
- M. Accessories to coil piping components shall conform to the following:
1. Nexus PT Pressure/Temperature test plugs shall be rated for 1000 psi, 325° F, with brass body, Nordel check plugs, and sealed cap.
 2. Flexible hoses shall be designed for water, and fire retarding conform to ASTM codes E84-00, with stainless steel outer braid.
 3. Hoses (½" thru 1"), Nexus UFHF:
 - a. Shall have a Kevlar reinforced EPDM tube core, brass end fittings, and designed for a working pressure of 400 psi, 248°F.
 - b. Provide dual union or swivel end fittings.
 4. Hoses (1¼" thru 2"), Nexus UFHM:
 - a. Shall have Rayon reinforced EPDM tube core, brass end fittings, and designed for a working pressure of 300 psi, 248° F. The (2½") hose shall have stainless steel outer braid and carbon steel Sch. 40 fittings, and designed for a working pressure of 400 psi, 70° F.
 - b. Provide least one union or swivel end fitting
 5. Nexus MV Manual air vents shall be of brass construction and rated at 400 psi, 325° F.
 6. Shaft extensions (2" and smaller) for insulated pipe shall be at least 2¼" tall and constructed of brass

2.8 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Automatic Air Vent: designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection. Seton, Brady, or approved equal.
- C. Expansion Tanks: Taco Model CA, or approved equal. Construction: Welded steel, designed, tested and stamped in accordance with ASME (BPV code sec VIII, div 1); supplied with National Board Form U-1, rated for working pressure of (125/150 psi), with flexible heavy duty butyl rubber bladder. Bladder shall be able to accept the full volume of the expansion tank and shall be removable and replaceable. Bladder shall be NSF 61 rated for potable water service and shall be manufactured with FDA approved materials.
- D. Expansion tank isolation valves: Provide valve lockouts: shall meet OSHA requirements to ensure ball valves are locked securely and effectively; for use on 1/4-turn valves to prevent

tampering; polypropylene material resists chemicals, solvents, cracking & rust; provide padlock locking mechanism. Seton, Brady, or approved equal.

E. Air and Dirt Separator

1. Provide air and dirt removal devices of the size and type as shown on the plans. Air and dirt separation devices shall be Taco 4900 Series or approved equal by Spirovent or Bell & Gossett.
2. Air and dirt removal device shall be constructed of steel designed and fabricated per Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code with a maximum working pressure rating of 125 psi at 270°F.

F. Y-Pattern Strainers: Strainers shall be Y-type with removable basket. Body shall have cast-in arrows to indicate direction of flow. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel. Provide fine-mesh start-up strainers. Strainers in sizes 3-inch and smaller shall have screwed ends; Hammond 3010, or approved equal. Body material shall be cast bronze conforming to ASTM B584-C84400. Strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer screens shall have perforations not to exceed 1/32". In sizes 4 and larger, strainers shall have flanged ends; Hammond 3030, or approved equal. Body material shall be cast iron conforming to ASTM A126 Class B. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Strainer screens shall have perforations not to exceed 1/16" (4" size); 1/8" (5" size and larger).

2.9 WATER TREATMENT FOR CLOSED LOOP HYDRONIC SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Sentinel
2. Anderson Chemical Company.
3. Aqua-Chem, Inc.
4. Barclay Water Management, Inc.
5. General Electric Company; GE Water & Process Technologies.
6. H-O-H Water Technology, Inc.
7. Metro Group, Inc. (The); Metropolitan Refining Div.
8. Nalco; an Ecolab company.
9. Watcon, Inc.

B. Performance Requirements

1. Provide water treatment for closed-loop hydronic systems.
2. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
3. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

4. Closed hydronic systems, including shall have the following water qualities:
 - a. pH: Maintain a value within 8.2 to 9.5.
 - b. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - c. Total Hardness : <150 ppm as CaCO_3 .
 - d. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 - e. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - f. TSS: Maintain a maximum value of 10 ppm.
 - g. Ammonia: Maintain a maximum value of 20 ppm.
 - h. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 - i. Microbiological Limits:
 - 1) Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
 - 2) Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
 - 3) Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
 - 4) Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
 - 5) Iron Bacteria: Maintain a maximum value of zero organisms/mL.
- C. Bypass Chemical Feeder: Neptune Model DBF-2HP, J. L. Wingert Company, or approved equal; welded steel construction; 2-gallon capacity; with inlet, outlet, and drain valves.
 1. The feeder shell shall be constructed of 10 gauge steel minimum. Tank heads shall be a minimum 9 gauge steel. The bypass feeder shall be rated at 300 psi and to 200°F.
 2. The tank shall have a wide mouth, 3-1/2" opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal.
 3. The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall use a square ring gasket seal.
- D. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 HYDRONIC PIPING APPLICATIONS – ABOVE GROUND

- A. Hot Water, NPS 2 and Smaller: Type L drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints; or PEX-a piping.
- B. Hot Water, NPS 2-1/2 and Larger: Schedule 40 steel pipe with welded or welded and flanged joints.
- C. Makeup water piping, downstream of backflow preventer: Type L, drawn-temper copper tubing; PEX-a piping.

- D. Drain Lines: ¾" minimum diameter; PVC or DWV Copper Tubing: ASTM B 306, Type DWV.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.3 VALVE APPLICATIONS

- A. Hydronic Valve Applications: Shutoff Duty: Ball and butterfly valves. Throttling Duty: Globe, ball, and butterfly valves.
- B. 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.
- C. Install calibrated balancing valves in the return water line of terminal units, as indicated, and as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

3.4 HYDRONIC PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Common Work Results for Mechanical" for basic piping installation requirements.
- B. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs at no additional cost. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- C. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

- D. Refer to Division 23 Section "Common Work Results for Mechanical" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.
- E. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid or flexible, where required, grooved-end-pipe couplings. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
- F. PEX Piping
1. Install PEX-a tubing according to manufacturer's recommendations.
 2. PEX-a Piping Hanger Spacing: Install hangers for PEX-a piping with the following maximum spacing: 1 inch and below: Maximum span, 32 inches. 1¼ inch and above: Maximum span, 48 inches. PEX-a Piping Hanger Spacing with PEX-a Support Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing: Maximum span, 8 feet. PEX-a Riser Supports: Install CTS riser clamps at the base of each floor and at the top of every other floor. Install mid-story guides between each floor.
 3. Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for F1960 connections.
- G. Hydronic piping systems shall be provided to permit the system to be drained. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and hose-end fitting with cap, at low points in piping system mains and elsewhere as required for system drainage.
- H. Install piping at a uniform grade of 0.2 percent upward in direction of flow. Pipe size at connections to equipment shall be distribution main size, not connection size. Reduce pipe sizes using eccentric reducer fitting installed with level side up. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- I. Provide dielectric fittings as specified in Section 230500. Install unions or flanges in piping, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- J. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, and elsewhere as indicated or recommended by component manufacturer to have strainer protection. Provide valved drain and hose connection on strainer blow down connection. Install with provisions for service clearance. Remove and clean strainer after 24 hours of operation and after 30 days of operation.

- K. 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. Check the settings and operation of each safety valve, including valves furnished by heater manufacturer. Record settings.
- L. Install radiant floor heating per tubing manufacturer's written instructions and heating design layout per Radiant Floor Heating, Section 238316, and as scheduled on drawings.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports."

3.6 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. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- B. Expansion tank to be installed on the suction side of the system pumps. Expansion tank to be tied into system piping in close proximity to air separator and system fill line. Install piping to expansion tank with a 2 percent upward slope toward tank.
- C. Install expansion tanks on concrete pad. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements. Do not install drain valve.
- D. Install bypass chemical feeder suspended off floor or on pad.

3.7 CONTROL VALVE INSTALLATION

- A. Perform the following as directed by the BAS contractor:
 - 1. Install modulating control valves with minimum of 10 pipe diameters straight pipe at inlet and 5 pipe diameters straight pipe at outlet.
 - 2. Installation of immersion wells and pressure tapplings, along with associated shut-off cocks.
 - 3. Installation of flow switches.
 - 4. Setting of automatic control valves or other control devices.
- B. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- C. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.

- D. Valves shall be installed in accordance with the manufacturer's recommendations. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- E. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Arrange piping with offsets to allow for expansion, as well as terminal unit removal.

3.9 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the water characteristics described in Part 2.
- B. Provide bypass chemical feeders in each hydronic system where indicated.
 - 1. Install in upright position with top of funnel not more than 48 inches above the floor.
 - 2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
 - 3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.
- C. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 6 feet per second, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the commissioning agent.
- D. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water. Circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by

flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 6 feet per second. Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

- E. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.
- F. Close and fill system as soon as possible after final flushing to minimize corrosion. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.10 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during 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 the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.

- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. 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).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following: Division 23 Section "Common Work Results for HVAC"

1.2 SUMMARY

- A. This Section includes hydronic pumps and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.
- 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate electrical power with Division 26.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Taco (Basis of Design)
 - 2. Armstrong
 - 3. Bell & Gossett ITT
 - 4. PACO
 - 5. Grundfos
 - 6. Patterson
 - 7. Wilo

2.2 GENERAL PUMP REQUIREMENTS

- A. Pump Units: Factory assembled and tested.
- B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be non-overloading over full range of pump performance curve. Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Motors Indicated to be premium efficiency, and shall meet or exceed all NEMA Standards Publication MG1 requirements and comply with NEMA premium efficiency levels Class B temperature rise; Class F insulation.

2.3 WET ROTOR CIRCULATORS

- A. Constant Speed Circulators.
 - 1. The circulator shall be water lubricated, direct drive, requiring no seals, couplers or bearing assembly. Ceramic shaft and carbon bearing construction.

2. The circulator shall be repairable in-line without removal of the circulator from the piping using a stainless steel replaceable cartridge. Cartridge shall be provided with a 3 year warranty.
3. Provide “-IFC” integral flow check.
4. For chilled water pumps provide an Anti-Condensate Baffle (ACB) to Protect Motor Windings.
5. Circulator can be either direct acting or reverse acting. Circulator shall be rated for 125 psi working pressure. Circulator shall bear UL label.

2.4 PUMP SPECIALTY FITTINGS

- A. Pumps without VFD’s shall be fitted with a discharge multi-purpose balancing valve or other means of providing system balance, isolation, and check feature for reverse flow. The valve shall be straight or angle pattern and shall be field convertible between the two. The valve shall be ductile iron and rated for 250 psi working pressure. The valve flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 psi flanges or ANSI class 250 flanges. The valve shall include the following components; non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Valve shall be serviceable under full system pressure. The valve shall be a Taco model MPV Plus Two multi-purpose valve or equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations for compliance with requirements for installation. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Provide pumps and equipment according to manufacturer's written instructions.
- B. Provide pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- C. Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors.
- D. Pumps shall **NOT** be run dry to check rotation.

3.3 INLINE PUMPS

- A. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Provide valves that are the same size as piping connected to pumps.
- D. Provide suction and discharge pipe sizes equal to or greater than diameter of pump nozzles. Provide fittings and specialties as detailed on the plans.
- E. Provide a single gage with three-input selector valve; locate at pump suction and discharge tapings, also strainer.
- F. Provide electrical connections for power, controls, and devices. Electrical power and control wiring and connections are specified in Electrical Specification Sections. Ground equipment. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 COMMISSIONING

- A. Verify that pumps are installed and connected according to the Contract Documents. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents. Complete installation and startup checks according to manufacturer's written instructions.
- B. Check piping connections for tightness.
- C. Clean strainers on suction piping.
- D. Perform the following startup checks for each pump before starting:
 - 1. Verify bearing lubrication.
 - 2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 3. Verify that pump is rotating in the correct direction.
- E. Prime pump by opening suction valves and closing drains, and prepare pump for operation. Start motor. Open discharge valve slowly.
- F. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.6 DEMONSTRATION

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals.

END OF SECTION 232123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results"
 - 2. Division 23 Section "Air Cooled Condensing Units"

1.2 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves and specialties.
 - 3. Refrigerants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
- B. Shop Drawings:
 - 1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
 - 2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
 - 3. Show interface and spatial relationships between piping and equipment.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L, ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.

2.2 VALVES AND SPECIALTIES

- A. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Copper spring.
 - 5. Working Pressure Rating: 500 psig.
- B. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
 - 1. Body and Bonnet: Plated steel.
 - 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Threaded.

5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and AC coil.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
- C. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Reverse-flow option (for heat-pump applications).
 6. End Connections: Socket, flare, or threaded union.

PART 3 - EXECUTION

3.1 VALVE AND SPECIALTY APPLICATIONS

- A. Install thermostatic expansion valves as close as possible to distributors on evaporators.
1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- B. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

3.2 PIPING 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- L. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

3.3 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube." Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments: Adjustable steel clevis hangers. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

3.6 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 - 4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of controllers to the system design temperature.

END OF SECTION 232300

SECTION 233113 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 8 for Access Doors
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Mechanical Insulation"
 - 4. Division 23 Section "Air Terminals"
 - 5. Division 23 Section "Diffusers, Registers, and Grilles."
 - 6. Division 23 Control Section
 - 7. Division 23 Section "Testing, Adjusting, and Balancing".

1.2 SUMMARY

- A. This Section includes ducts and accessories.

1.3 SYSTEM DESCRIPTION

- A. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions, which may be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- B. The contractor must comply with the enclosed specification in its entirety. If on inspections, the engineer finds changes have been made without prior written approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.
- C. At the discretion of the engineer, sheet metal gauges, and reinforcing may be randomly checked to verify all duct construction is in compliance.

1.4 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 Schedule" Article.

- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1. Exception: Sheet metal surfaces and fasteners.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Fittings.
 - 4. Reinforcement and spacing.
 - 5. Seam and joint construction.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Equipment installation based on equipment being used on Project.
 - 8. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- D. Ductwork Specialties Product Data; provide for the following:
 - 1. Sealant
 - 2. Duct-mounted access doors and panels.
 - 3. Flexible ducts.
 - 4. Backdraft dampers.
 - 5. Manual-volume dampers: Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval.
 - 6. Louvers: Include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals. For units with factory-applied color finishes, provide

color chart. Provide product test reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 INFORMATIONAL SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- B. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. National Fire Protection Association (NFPA)
 - 1. 90A: Standard for the Installation of Air Conditioning and Ventilating Systems
 - 2. 96-2008: Ventilation Control and Fire Protection of Commercial Cooking Operations
- D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. 3rd Edition: 2005 HVAC Duct Construction Standards, Metal and Flexible
 - 2. 1st Edition: 2012 ANSI/SMACNA 016-2012 HVAC Air Duct Leakage Test Manual

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and fire stopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Deliver, store and handle materials according to manufacturer's written recommendations.
- C. All ductwork, equipment, and fittings delivered and stored on the job site must be capped to prevent the entry of moisture, construction dust or other debris.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M. Galvanized Coating Designation: G60 or G90 as indicated. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Reinforcement Shapes and Plates: ASTM A-36/A-36M, steel plates, shapes, and bars; black and galvanized.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. 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 un-braced panel area, unless ducts are lined. All large ducts must be braced as required to prevent drumming.
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable

sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fig. 2-3 Rectangular Elbows: Type RE2 square throat with vanes, Type RE1 radius (1.5W minimum), or Type RE5 dual radius. Square throat is not allowed.
2. Vane support in elbows: Fig 2-4. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Mounting rails shall have friction insert tabs that align the vanes automatically. Tab spacing shall be as specified in Figure 2-3 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Second Edition standard. Rail systems with non-standard tab spacing shall not be accepted. Due to tensile loading, vanes shall be capable of supporting 250 pounds when secured according to the manufacturer's instructions.
3. Fig. 2-5 Rectangular Divided Flow Branches: Type 1, Type 2, Type 4A, or 4B.
4. Fig. 2-6 Branch Connections: 45-degree entry, 45-degree lead-in, bell-mouth or spin-in (single diffuser supply only).
5. Fig. 2-7 Offsets and Transitions. Use gradual offsets as shown, 90-degree offsets shall be avoided.
6. Fig 2-9 Duct Coils: Duct coils with transitions and upstream access door as shown.

2.3 ROUND DUCT FABRICATION

- A. Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" latest edition.
- B. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Exposed Round Ducts: Shall be Spiral Seam (RL-1 seam) at 2-inch wg construction.
 2. Concealed Round Ducts: Shall be longitudinal Grooved Seam Flat lock (RL-5 seam) at 2-inch wg construction.
 3. Snap lock seams shall not be used for this project.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Outdoor Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A-603. 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.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- G. Supports For Roof Mounted Items:
 - 1. Equipment rails shall be galvanized steel, minimum 18-gauge, with integral baseplate, continuous welded corner seams, factory installed 2x4 treated wood nailer, 18-gauge galvanized steel counter flashing cap with screws, built-in cant strip; minimum height 11 inches. Provide raised cant strip to start at the upper surface of the insulation.
 - 2. Pipe/duct pedestals: Provide a galvanized unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.

2.5 SEALANT MATERIALS

- A. Joint Sealant/Mastic: Shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall prevent the entry of water, air and moisture into the duct system. Sealer shall be UL 723 listed; UL 181A-M or 181B-M listed; and meet NFPA 90A requirements. Pressure sensitive tape shall not be used as a sealing mechanism.
 - 1. Maximum 5 flame spread and 0 smoke-developed (ASTM E-84 Tunnel Test).
 - 2. Generally provide liquid sealant for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger.
 - 3. Resistance to mold, mildew and water: Excellent
 - 4. Color: Gray
 - 5. Duct sealant/mastic shall meet requirement for "LEED IEQ Credit 4.1: Low Emitting Materials: Adhesive and Sealant". ITW TACC Miracle Kingco water-based sealants, or approved equal.
- B. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- C. Round Duct Joint O-Ring Seals: 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.

Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 FITTINGS

- A. Tees, Laterals, and Conical Tees: Use 45 degree; fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Diameters 3 through 8 inches shall be two-section die stamped; all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.

2.7 LOUVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ruskin Company
 - 2. American Warming and Ventilating, Inc.
 - 3. Arrow United Industries.
 - 4. Cesco Products.
 - 5. Construction Specialties, Inc.
 - 6. Greenheck.
- B. Louvers shall be AMCA Licensed. Louvers shall comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- C. Fabrication: Design: Stationary drainable louver type with drain gutters in each blade and head with downspouts in jambs and mullions with all welded construction. Hidden vertical supports to allow continuous line appearance up to 120 inches. Steeply angled integral sill. Frame Depth: 4 inches; Wall Thickness: 0.081 inch nominal. Material: Extruded aluminum, Alloy 6063-T6. Blades: Style: Drainable. 45 degrees at 4 inches nominal. Wall Thickness: 0.081 inch nominal. Material: Extruded aluminum, Alloy 6063-T6. Recycled Content: 18% post-consumer. 55% pre-consumer, post-industrial, total 73% by weight.
- D. Performance Data: Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500.
 - 1. Free Area: 52 percent, nominal.
 - 2. Free Area Size: 8.34 square feet.
 - 3. Maximum Recommended Air Flow through Free Area: 1075 feet per minute.
 - 4. Air Flow: 8966 cubic feet per minute.
 - 5. Maximum Pressure Drop (Intake): 0.225 inches w.g.

6. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1075 feet per minute free area velocity when tested for 15 minutes.
 7. Design Wind load: Per Code.
 8. Louvers shall be factory engineered to withstand the specified seismic loads. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).
- E. Bird Screen: aluminum, 5/8” mesh, removable frame, re-wireable.
- F. Premium Kynar Paint Finish: Before paint application, louvers shall be thoroughly cleaned and pretreated. Cleaning includes complete submersion in alkali cleaner, detergent deoxidization, amorphous chrome phosphate conversion ® ® coating and acidulated final rinse. Kynar 500 or Hylar 5000 finish shall be applied to provide 1.2 mils factory applied, baked-on film build in accordance with AAMA 2605-98* “Voluntary Specification Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels”. Color shall be as selected by Architect.
- G. Accessories
1. Insulated Blank-Off Panels: 0.040 aluminum sheet, 2 inches thick, aluminum skin insulated core, factory installed with removable fasteners and neoprene gaskets.
 2. Aluminum Insect Screen - 18-16 mesh, mill finish, .011 inch wire.

2.8 MANUAL-VOLUME DAMPERS

- A. Manual balancing dampers meeting the following specifications shall be furnished and installed on all branch ducts and where shown on plans. Testing and ratings to be in accordance with AMCA Standard 500-D.
- B. Single-Blade Rectangular Dampers shall consist of: an 18 ga. galvanized steel frame with 3-1/2 in. depth; blades fabricated from 20 ga. galvanized steel; integral 1/2 in. diameter axles. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD-10.
- C. Multi-Blade Rectangular Dampers shall consist of: a 16 ga. galvanized steel hat channel frame with 5 in. depth; triple V type blades fabricated from 16 ga. galvanized steel; ½ in. dia. plated steel axles; external (out of the airstream) blade-to-blade linkage. Damper suitable for pressures to 4.0 in. w.g. (996 Pa), velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD15.
- D. Round dampers shall consist of: a 20 ga. galvanized steel frame with 6 in. depth; blades fabricated from 20 ga. galvanized steel; 3/8 in. square plated steel axles turning in acetal bearings. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBDR50.

2.9 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff
 2. Ventfabrics, Inc.
 3. Young Regulator Company.
- B. Ratings: Temperature Rating: -25°F to 180°F; Air Flow Rating: 1,500 fpm; Differential Pressure Rating: 1 in. wg.
- C. Construction:
1. Basis of Design: Pottorff Model RCS-10 (rectangular); RCS-10R (round)
 2. Frame: 6" x minimum 22 gauge, roll formed galvanized steel with reinforcing beads at each end.
 3. Blade: Round, minimum 22 gauge, galvanized steel with center formed V for added rigidity. Flat blades are not acceptable.
 4. Axles: Minimum 3/8" square plated steel, mechanically attached to blade. Bearings: Molded synthetic, sleeve-type turning in tight sealing hole in frame.
 5. Mounting: Vertical and/or Horizontal
 6. Actuator: Remote cable controlled quadrant shall be factory installed to the damper, attached to a minimum 36 inch long flexible cable controlled, and controlled by a 3/16 inch Allen hex-head drive with 15/16 inch round white finishing plug (suitable for painting) and integral side-mounting flange. The entire assembly shall be factory assembled and tested prior to shipment, field assembled systems are not acceptable.
 7. Finish: Mill galvanized.

2.10 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.
 2. Cesco Products
 3. Greenheck Fan Corporation.
 4. METALAIRE, Inc.
 5. Nailor Industries Inc.
 6. Prefco
 7. Ruskin Company.
- B. Type: Static; rated and labeled according to UL 555S by an NRTL.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

- E. Mounting Sleeve: Factory-provided.
- 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. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Heat-Responsive Device: Replaceable, 165°F rated, fusible links.

2.11 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill Air Flow LLC.
 - 4. Nailor Industries Inc.
 - 5. Durodyne
 - 6. Cesco
 - 7. Buckley
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door: Double wall, rated for up to 4.5" static pressure. Door panel filled with 1" fiberglass insulation; ¾ lb. density. Hinges and Latches: 1-by-1-inch continuous piano hinge and cam latches. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs.
 - 3. Provide 1/8" thick neoprene gaskets.
 - 4. Locks: Access doors less than 16 Inches Square: Two cam locks. Doors over 16" shall have four locks.

2.12 FLEXIBLE CONNECTORS

- A. Provide for all air moving equipment. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 0 or 1. Factory fabricated with a strip of fabric 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 aluminum sheets. Select metal compatible with connected ducts. Duro-Dyne, Hardcast, or approved equal.
- B. Indoor Flexible Connector Fabric: Glass fabric double coated with polychloroprene or neoprene. Minimum Weight: 26 oz. /sq. yd. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

2.13 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 0 or 1. Flame Spread: Less than 25; Smoke Developed: Less than 50.
- B. All products shall be certified by Greenguard Environmental Institute; independent testing of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Greenguard provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO.
- C. Rated Positive Pressure: 10" w.g. per UL-181. Maximum negative pressure: ¾".
- D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
 - 1. R6 insulation, Basis of Design: Atco #86
 - 2. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 3. Jacket (inner and outer): Polyethylene film.
- E. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- F. Hangers shall be band type, 1" wide minimum.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- B. Provide volume dampers at all branch ducts to RGD's. If volume dampers are inadvertently not shown, contractor shall provide, the intent is to provide volume dampers at all branches.
- C. Provide ducts and accessories according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- D. Construct and install each duct system for the specific duct pressure classification indicated.

- E. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved, if cross sectional area is maintained.
- F. Provide ducts in lengths not less than 12 feet, unless interrupted by fittings. Provide ducts with fewest possible joints.
- G. Provide fabricated fittings for changes in directions, changes in size and shape, and connections.
- H. Provide couplings tight to duct wall surface with a minimum of projections into duct.
- I. Provide ductwork to allow maximum headroom. Provide ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Provide ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- J. Provide ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- K. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- L. Coordinate layout with suspended ceiling, lighting layouts, and similar finished work.
- M. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

3.2 MATERIALS

- A. Hangers, accessories, and dampers shall be same material as parent duct.
- B. Refer to Specification Section 230700 for sheet metal covering of rigid insulation for protection from maintenance personnel crossing insulated ductwork in mechanical spaces.
- C. All ducts shall be G60 galvanized steel except as follows:
 - 1. Louver sleeves and plenums: G90 galvanized steel.
 - 2. Plenums at outside louvers: G90 galvanized steel, water-tight, pitched to drain. Provide low-point drain fittings at low points.

3.3 DUCT CLASSIFICATIONS AND SEALING

- A. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
 - 1. Supply Ducts: 2-inch wg.
 - 2. Return Ducts: 2-inch wg, negative pressure.
 - 3. Exhaust Ducts: 2-inch wg, negative pressure.

B. Seam And Joint Sealing

1. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
2. Seal externally insulated ducts before insulation installation.

3.4 DUCT PENETRATIONS

- A. Fire or Smoke Rated Penetrations not requiring a fire and/or smoke damper: Where ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and fire dampers are not required, the opening in the construction around the duct shall be as follows:
 1. Not exceeding a 1" average clearance on all sides.
 2. Filled solid with firestopping material as specified in Section 230500.
- B. Fire or Smoke Rated Penetrations: Provide fire and/or smoke damper as specified under Duct Accessories paragraph.
- C. Non-Fire-Rated Concealed Penetrations: Provide insulation infill and acoustical sealant around gaps. Tightly seal to prevent sound transmission. Neatly finish.
- D. Roof penetrations by ducts shall use counter-flashed curbs.
- E. Flexible air ducts or connectors shall not pass through any wall, floor, or ceiling.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Provide powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- E. Provide upper attachments to structures. Select and size upper attachments with pull-out, tension,

3.6 FLEXIBLE DUCT

- A. Provide in accordance with manufacturer's and Air Diffusion Council recommendations.
- B. Flexible ducts shall be supported at manufacturer's recommended intervals, but at no greater distance than 5 feet. Maximum permissible sag is 1/2" per foot of spacing between supports.
- C. Provide duct fully extended; do not install in the compressed state or use excess lengths.
- D. Avoid bending ducts across sharp corners or incidental contact with metal fixtures, pipes, conduits, or hot equipment. Radius at centerline shall not be less than one duct diameter.
- E. Hanger or saddle material in contact with the duct shall be at least 1-1/2" wide.
- F. Provide at least 2 duct diameters of straight duct at the entrance to register, grilles, and diffusers.

3.7 DUCT ACCESSORIES INSTALLATION

- A. Provide duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".
- B. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards
- C. Each register, grille, or diffuser shall have a means of air flow adjustment. Provide volume damper in branch duct if not furnished with the RGD.
- D. Adjust operable devices for proper action.
- E. Perform the following as directed by the controls contractor:
 - 1. Installation of control devices
 - 2. Access doors where indicated and as required.
- F. Provide duct access panels for access components that require servicing.
 - 1. Provide duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining per equipment manufacturers' requirements.
 - 2. Provide access panels on side of duct where adequate clearance is available.
 - 3. Locate panel upstream and/or downstream as recommended by manufacturer.

4. Locations:
 - a. On both sides of duct coils.
 - b. Upstream from duct filters.
 - c. At outdoor-air intakes.
 - d. Adjacent to and close enough to life safety dampers, to reset or reinstall fusible links. Access doors for access to dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - e. Control devices requiring inspection.
 - f. Elsewhere as indicated or required by duct accessory manufacturer
5. Inspect locations of access doors and verify that purpose of access door can be performed.

G. Control Damper Installation

1. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
2. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure $\frac{1}{4}$ in. larger than damper dimensions and shall be square, straight, and level.
3. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within $\frac{1}{8}$ in. of each other.
4. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
5. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
6. Provide a visible and accessible indication of damper position on the drive shaft end.
7. Support ductwork in area of damper when required to prevent sagging due to damper weight.
8. After installation of low-leakage dampers with seals, caulk between frame and duct opening to prevent leakage around perimeter of damper.

H. Fire Damper Installation

1. Examine areas to receive dampers. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected
2. Provide dampers in accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings. Any damper installation that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
3. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or

plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.

4. Provide dampers square and free from racking.
5. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
6. Do not compress or stretch the damper frame into the duct or opening.
7. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Provide support mullions as reinforcement between assemblies as required.
8. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.
9. Provide access door, properly located for serving.
10. Tests and Inspections: Operate dampers to verify full range of movement and verify that proper heat-response device is installed.

3.8 LOUVER INSTALLATION

- A. Louvers to be furnished by Division 23; mounted and installed by the contractor responsible for the outside wall construction. Ductwork shall be connected to the louvers by Division 23.
- B. Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. For new construction, or where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.
- C. Installation
 1. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
 2. Pitch horizontal ducts and plenums connected to louvers downward toward louvers not less than 1 inch in 10 feet. Connect to louver to allow drainage to exterior. Seal duct water-tight.
 3. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.
 4. Form closely fitted joints with exposed connections accurately located and secured.
 5. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
 6. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
 7. Provide concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather tight louver joints are required.
- D. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning. Restore louvers and vents damaged during installation and construction so no

evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

3.9 FIELD QUALITY CONTROL

- A. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- B. HVAC systems shall not be operated during construction.
- C. Systems shall not be operated without filters in place.
- D. Upon completion of installation duct systems and before HVAC system start-up, visually inspect the ductwork proper installation
- E. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork. Turn the HVAC system on and allow it to run until steady state operation is reached. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
- F. All ductwork shall be provided with temporary enclosures to keep the HVAC system free of dust and construction debris. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire duct from the points where the air enters the system to the points where the air is discharged from the system.
- G. Check all filters in accordance with their manufacturer's instructions. Use specified grade of filters at all times that system is operating.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

END OF SECTION 233113

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for HVAC"
 - 2. Division 23 Section "Ductwork"
 - 3. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper.

1.4 SUBMITTALS

- A. Each manufacturer shall check noise level ratings for registers and diffusers to insure that the sizes selected will not produce noise to exceed 30 db, "A" scale, measured at occupant level; notify Owner's representative of problems prior to shop drawing submittal.
- B. Pressure drop, airflow and noise criteria selection is based on design equipment. Manufacturers not submitting design makes must provide written certification in front of submittal that equipment submitted has been checked against and performs equal to the design make.
- C. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.

2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- D. Coordinate locations with reflected ceiling plans and wall elevations as applicable.
- E. Coordinate mounting frame with associated mounting surface.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."
- C. Sound pressure levels shall be determined by using AHRI Standard 885-2008 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Outlets".

PART 2 - PRODUCTS

2.1 GENERAL

- A. Diffusers, registers, and grilles are scheduled on Drawings.
- B. Mounting type shall match the mounting surface. Coordinate with mounting conditions.
- C. Material shall match the specified ductwork. Coordinate with Section 233113 "Ductwork".
- D. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Grilles shall be finished in White Powder Coat, unless noted otherwise.
- F. Manufacturers
 1. Price
 2. Titus
 3. Metal-Aire
 4. Anemostat
 5. Nailor

2.2 RETURN OR EXHAUST

A. Return/Exhaust Grille, 45-degree deflection

1. Material: aluminum (Price 630 Series)
2. Provide damper as scheduled.
3. Grilles of the sizes indicated on the plans. Grilles shall be 45 degree deflection fixed louver type with blades spaced 3/4" on center. The blades shall run parallel to the long short dimension of the grille.

2.3 SUPPLY

A. Square ceiling diffusers, Adjustable pattern

1. Material: steel (Price Model SCDA)
2. Diffusers shall consist of a precision formed back cone of one piece seamless construction which incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct.
3. The diffuser shall integrate with all duct sizes shown on the plans without affecting the face size and appearance of the unit.
4. The inner cone assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck.
5. Non-protrusive airflow directional tabs shall be provided on the back of the inner cones which may be positioned for either horizontal or vertical discharge.

B. High Velocity Diffuser

1. Material: heavy gauge aluminum construction (AirConcepts, Inc, model SPD series).
2. Ceiling mounted.
3. Standard White finish.
4. Horizontal Air Pattern
5. Provide acoustical tile mounting kit where required.

C. Linear Vane Diffusers

1. Material: Aluminum (Price Model LV1) one way deflection fixed louvers.
2. Vane depth shall be a minimal 1 3/8".
3. The core shall be of mandrel tube construction and removable from the outer border for installation.
4. The diffuser border shall be heavy extruded aluminum construction.
5. Diffusers shall have adjustable directional vanes.
6. The diffuser border shall be Type 500 (1/2") surface mount.

PART 3 - EXECUTION

3.1 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. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Provide diffusers, registers, and grilles with airtight connection to ducts.
- D. Provide 2 feet minimum of straight ductwork at the entrance to diffusers.
- E. Plenum boxes on grilles/registers shall be 8" minimum height.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- B. Adjustable outlet diffuser: adjust pattern for draft-free air distribution.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Packaged Energy Recovery Units – Fixed Plate Enthalpic

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, furnished specialties, and accessories.
- B. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ARI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Rating Air-to-Air Energy Recovery Equipment."
- C. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 - 2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
- D. UL Compliance: UL 1812.

1.5 COORDINATION

- A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.6 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. ERU Filters: Furnish (2) sets of spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS – FIXED PLATE ENTHALPIC

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mitsubishi Electric Sales Canada Inc.
 - 2. RenewAire LLC.
- B. Quality Assurance
 - 1. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.
 - 2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
 - 3. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. Some exceptions to UL Listing may apply. Units intended for "Outdoor Use" shall be listed using the specific UL requirements for rain penetration, corrosion protection and seal durability and shall be so labeled.
 - 4. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of

manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

C. Performance

1. Energy Transfer: The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
2. Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.
3. Continuous Ventilation: Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters, or defrost cycles under normal operating conditions.
4. Positive Airstream Separation: Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by “porous plate” mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix.
5. Laminar Flow: Airflow through the ERV core shall be laminar over the products entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange plate material.

D. Construction

1. The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
2. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
3. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners. The unit roof shall be one piece or have watertight standing seam joints and shall overlap wall panels and doors in order to positively shed water.
4. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets rated for outdoor exposure. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.
5. Weather hoods shall be screened to exclude birds and animals. Inlet weather hoods shall be sized to maintain inlet velocities below 500 fpm, and equipped with rain excluder baffles.
6. Case walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft²·°F/BTU).
7. The ERV cores shall be protected by a MERV-8 rated, 2” nominal, pleated, disposable filter in both airstreams.
8. Unit shall have single-point power connection and a single-point 24 VAC contactor control connection

9. Blower motors shall be direct drive models (EV450 and HE1XRT models) and shall be EISA compliant for energy efficiency with open drip proof design and integral thermal protection.
10. Blowers shall be quiet running, forward curve type and be either direct drive (EV450 and HE1X RT only)
11. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.

E. Options

1. Roof top unit shall have factory painted cabinet and hoods due to seacoast environment.
2. Provide factory installed disconnect fuses.
3. Provide high wind tie-down kit.
4. Provide ECM controlled motors (available for EV450IN and HE1XIN models) allowing for to preset speeds or variable speed operation with a 0-10 volt DC control signal. Provide factory remote speed controller.
5. Provide factory installed isolation dampers for either or both air streams. The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit transformer package and have a spring return for low off- position power consumption.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Locate and orient unit to provide the shortest and most straight duct connections. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.

3.2 INSTALLATION

- A. Install units with clearances for service and maintenance.
- B. Roof Mounted Units
 - 1. Install air-to-air energy recovery equipment on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 7. Secure air-to-air energy recovery equipment to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
 - 2. Install a structurally sound, weathertight, level and properly insulated roof curb with nailers, curb gasket and tie-downs to meet local wind load requirements.
 - 3. Insure roof decking penetrations inside curb are properly positioned and sized for ducts. Seal all penetrations and gaps between ducts and decking with appropriate fire, weather and acoustic sealant system.
 - 4. Install fiberglass batt insulation over the decking inside the curb. Insulation thickness to be determined by local thermal requirements.
 - 5. Use proper rigging, including spreader bars, for safe lifting and placement.
 - 6. Ductwork shall be installed to the curb duct adaptors before unit is set in place.
 - 7. Both the return and the supply ducts shall be thermally insulated at levels appropriate to the local climate from the unit through the curb and continuous until at least the first elbow or tee. A continuous vapor barrier shall also be provided on warm surface of the insulation.
- C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- D. Sound Control: To control sound associated with the two blower outlets:
 - 1. Provide straight, gradual transition ductwork for a minimum of 2-1/2 duct diameters downstream from the blower outlet.

3.3 CONNECTIONS

- A. Comply with requirements for ductwork specified in Division 23 Section "Ductwork."

3.4 FIELD QUALITY CONTROL

- A. Test and Balancing: Test and Balancing may not begin until 100% of the installation is complete and fully functional.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

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 safeties. Replace damaged and malfunctioning controls and equipment.
3. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 237200

SECTION 238130 – MULTI-SPLIT SYSTEMS AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230500 “Common Work Results for HVAC”

1.2 SUMMARY

- A. This Section includes:
 - 1. Multi split heat pump systems
 - 2. Automatic Temperature Controls
 - 3. Obtain Efficiency Maine Rebates for owner, as per Section 230500.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and Maintenance Data
- C. Schematic drawings for each controlled HVAC system indicating the following:
 - 1. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
 - 2. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
 - 3. A graphic showing location of control I/O in proper relationship to HVAC system.
 - 4. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
 - 5. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
 - 6. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
 - 7. Narrative sequence of operation.

- D. Control riser diagram indicating the following:
 - 1. Each device connected to network with unique identification for each.
 - 2. Interconnection of each different network in DDC system.
 - 3. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable type. Indicate raceway type and size for each.
- E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. All electrical work shall comply with the N.E.C. and local electrical codes.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. A dry air holding charge shall be provided in the indoor section.
- F. The outdoor unit shall be pre-charged with R-410a refrigerant for 70 feet of refrigerant tubing.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Refer to Section 230500.
- B. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition.
- C. Coordinate details of telephone line, internet service provider, and associated requirements.
- D. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.
- E. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

- F. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the controls system specified in this section. These controls shall be integrated into the system and coordinated by the contractor.

1.6 WARRANTY

- A. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have an extended warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.
- B. Provide remote service diagnostic monitoring from the nearest service location. At the request of the owner, a service diagnostic call will be made to troubleshoot and resolve (if possible) any reported system complaints. The owner will provide a dedicated telephone line for connection to the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mitsubishi (Basis of Design)
 - 2. Samsung
 - 3. Fujitsu
 - 4. Trane
 - 5. Daikin

2.2 OUTDOOR UNITS

- A. The Mitsubishi MXZ HyperHeat outdoor units shall be specifically designed to work with the manufacturer's family of indoor units. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory prior to shipment.
- B. Systems shall provide 100% heating capacity at 5°F, and heating performance down to -13°F.
- C. Unit Cabinet:
 - 1. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
 - 2. Cabinet color shall be Munsell 3Y 7.8/1.1.

3. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes.

D. Fan:

1. The unit shall be furnished with a direct drive, high performance propeller type fan.
2. The condenser fan motor shall be a variable speed, direct current (DC) motor and shall have permanently lubricated bearings.
3. Fan speed shall be switch automatically according to the number of operating indoor units and the compressor operating frequency.
4. The fan motor shall be mounted with vibration isolation for quiet operation.
5. The fan shall be provided with a raised guard to prevent contact with moving parts.
6. The outdoor unit shall have horizontal discharge airflow.
7. Outdoor unit sound level shall not exceed 55 dB (A).

E. Coil:

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. Coil and copper tubing to have Seacoast Condenser Coil Coating equal to **Blygold® PoluAl XT Coil Coating**.
2. The coil shall be protected with an integral guard.
3. Refrigerant flow from the outdoor unit to the indoor units shall be independently controlled by means of individual electronic linear expansion valves for each indoor unit.
4. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to one hundred and thirty-one (131) feet of refrigerant piping.
5. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.
6. All refrigerant connections between outdoor and indoor units shall be flare type.

F. Compressor:

1. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type.
2. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
3. The outdoor unit shall be equipped with a suction side refrigerant accumulator.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.

G. Branch Boxes:

1. The outdoor unit shall have a 3/8" liquid line connection and a 5/8" gas line connection. Pipe lines running from the outdoor unit shall connect to a 3-port, a 5-port branch box, or a combination of both.
2. The outdoor unit must be connected to at least one branch box. It can also be connected to two 3-port branch boxes, to one 3-port and one 5-port branch box, or to two 5-port branch boxes (At least two ports have to be left unused in this case).
3. The branch boxes shall be installed indoors in an area with a temperature between 67°F and 95°F and a relative humidity of 80% or lower.

H. Piping Requirements: The outdoor unit must have the ability to operate within the following refrigerant piping and height limitations without the need for line size changes, traps or additional oil.

I. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.
3. The outdoor unit shall be controlled by the microprocessors located in the indoor unit and in the outdoor unit communicating system status, operation, and instructions digitally over A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connection plus ground.
4. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control for maximum efficiency with minimum power consumption.

2.3 INDOOR UNITS

A. The indoor unit shall be fully factory assembled, wired and run tested prior to shipment. Contained within the indoor unit shall be all factory wiring, piping, control circuit board, fan, and fan motor. The unit shall have a self-diagnostic function, 3-minute restart time delay mechanism, an auto restart function, an emergency / test operation. Indoor unit shall be charged with dry air before shipment from factory.

B. The indoor units shall be capable of working with single-zone or multi-zone outdoor units.

C. Unit Cabinet:

1. The casing shall have a white finish– Munsell 1.0Y 9.2/0.2.
2. Multi directional drain and refrigerant piping, offering three (3) direction pipe alignment for all refrigerant piping and two (2) direction pipe alignment for condensate draining shall be standard.
3. Wall Mounted Units: There shall be a separate back plate that secures the indoor unit firmly to the wall. The installation-plate shall be securely attached to the wall using appropriate anchor method. Installing contractor shall determine the best method and be responsible for proper mounting of the installation plate to the wall.
4. Ceiling Recessed Units: Provide a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run

tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid. The cabinet panel shall have provisions for a field installed filtered outside air intake. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow. The unit shall include a condensate lift mechanism that will be able to raise drain water 19" inches above the condensate pan.

D. Fan - Wall Mounted Units:

1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
2. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearing.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down. Five (5) positions plus Auto and Swing shall be provided, controlled from the remote controller.
5. The indoor fan shall operate at one of five (5) speeds: Super High, High, Medium, Low, and Quiet plus Auto Fan Mode for models up to 18,000 BTU/h, and four (4) speeds: Powerful, High, Medium and Low plus Auto Fan Mode for the 24,000 BTU/h model. All speeds shall be selected from the remote controller.

E. Fan – Ceiling Recessed Units:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, Low, Mid, and High.
4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
5. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

F. Coil:

1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The refrigerant tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with PhosCopper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.
6. Provide the optional drain pan level switch (DPLS1), designed to connect to the control board, shall be provided, and installed on the condensate pan to prevent condensate from overflowing.

G. Electrical:

1. The indoor unit electrical power shall be 208 / 230 volts, 1-phase, 60 hertz.
2. The system shall be equipped with A-Control – a system allowing each indoor unit to be powered and controlled directly from the outdoor unit using a 14 gauge (AWG) 3-wire connection plus ground providing both primary power and integrated, bi-directional, digital control signal without additional connections.
3. The indoor units shall not have any supplemental or “back-up” electrical heating elements.

2.4 LINE SETS

A. PDM Preinsulated Pipes; “Gelcopper”, Mitsubishi Diamondback Linesets; or approved equal.

B. Polyethylene closed cell foam: assures thermal insulation from surroundings.

1. ASTM C 1427-07 compliant
2. Type I (tubular)
3. Grade I (insulation material for use on typical commercial system non-crosslinked).
4. Low-density polyethylene foam: closed cells foam, CFC and HCFC gas free
5. Water vapor permeability: ASTM E96-00 compliant
6. Working temperature: ASTM C 1427-07 compliant
7. Wall thickness: 1/2" and 3/4"
8. Surface burning characteristics: UL 94, top rated – UL 723,
9. ASTM E84 (25/50) compliant, flame and Spread Index less than 25 and Smoke Development Index less than 50 as tested according to UL 723.
10. R-Value: between 6.0 and 3.0 (depending on pipe diameter)

C. Copper

1. Pipes: Manufactured according to ASTM B280
2. Copper: No. C122200 DHP (phosphorous deoxidized, high residual phosphorous), 99.90%.
3. R410a approved.

D. Outer Jacket: Additional white polyethylene jacket cover protects foam insulation from tearing during installation process. Marking: insulation incrementally marked by every foot to ensure accurate initial unit charge. UV resistant. Paintable: The insulation can be painted to match the surroundings.

2.5 TEMPERATURE CONTROLS

A. Provide all labor, materials, equipment, and service necessary for a complete stand alone wireless thermostat control.

B. Provide all components in accordance with the manufacturer’s recommendations.

- C. Provide equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- D. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.
- F. Room Temperature Thermostats: Verify location of thermostats and other exposed control sensors with plans and room details before installation. Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of the sensor 48 inches above the floor to meet ADA requirements.
- G. Thermostats/controllers:
 - 1. Wall-mounted centralized controller (TC-24B) to be installed in Manager's office. This unit is to provide supervision of all heat pump zones.
 - 2. Hand Held Wireless (MHK1) serve the ten heat pump zones.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide units level and plumb.
- B. Roof support framework will be provided to support the bottom of the condensing units 30" minimum above the roof. Anchor units to supports with removable, cadmium-plated fasteners. Coordinate dimensions of this framework.
- C. Provide evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- D. Provide and connect pre-charged refrigerant tubing to component's quick-connect fittings. Provide tubing to allow access to unit.
- E. Provide raceways, boxes, and cabinets according to Division 26.
- F. Provide building wire and cable according to Division 26.
- G. Provide signal and communication cable according to Division 26.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide piping adjacent to unit to allow service and maintenance.
- C. Coordinate locations of indoor units with structure, ceiling grid, and other trades – must maintain heat pump manufacturer's recommended service clearances.
- D. Electrical Connections: Comply with requirements in Electrical Specification Sections for power wiring, switches, and motor controls.
- E. Provide insulated refrigerant piping per heat pump manufacturer's recommendations. Provide and connect pre-charged refrigerant tubing to component's quick-connect fittings. Provide tubing to allow access to unit. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
- F. Route indoor unit condensate drains to sink traps, floor drains, plumbing code compliant, or other locations as indicated.

3.3 SPLIT SYSTEM 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. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Engage a factory-authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions.
- E. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
- F. Refer to Division 1 for further requirements.

3.4 CONTROL SYSTEM 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.
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Perform initial settings that need to be made on the web browser.
 3. Test and adjust controls and safeties.
 4. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 5. Test each point through its full operating range to verify that safety and operating control set points are as required.
 6. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 7. Test each system for compliance with sequence of operation.
 8. Test software and hardware interlocks.
- B. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
- C. Calibrating and Adjusting:
1. Calibrate instruments.
 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Stroke and adjust dampers, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 5. Provide diagnostic and test instruments for calibration and adjustment of system.
- D. Adjust initial temperature set points.
- E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

END OF SECTION 238130

SECTION 238216 – DUCT MOUNTED HOT WATER HEATING COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for HVAC"

1.2 SUMMARY

- A. This Section includes HW heating air coils that are not an integral part of air-handling units.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.
- B. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Comply with ASHRAE 33 for methods of testing heating coils.

PART 2 - PRODUCTS

2.1 WATER COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trane.
 - 2. McQuay
 - 3. Aerofin Corporation.

4. Carrier Corporation.
 5. Coil Company, LLC.
 6. Dunham-Bush, Inc.
 7. Greenheck
 8. Super Radiator Coils.
 9. USA Coil & Air.
- B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Construction
1. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.
 2. Fins: Aluminum, minimum 0.006 inch thick.
 3. Headers: Seamless copper tube with brazed joints, prime coated.
 4. Frames: Galvanized-steel channel frame, minimum 0.052 inch thick for slip-in mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping.

END OF SECTION 238216

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for Mechanical"

1.2 SUMMARY

- A. This Section includes hydronic unit heaters.

1.3 SUBMITTALS

- A. Product Data: Include specialties and accessories for each unit type and configuration.
 - 1. Plans, elevations, sections, and details.
 - 2. Power, signal, and control wiring diagrams. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Equipment schedules to include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
 - 4. Cabinet Unit Heater color samples for initial selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- B. Maintenance Data: For unit heaters to include in maintenance manuals specified in Division 1. Include maintenance schedules and repair parts lists for motors, coils, integral controls, and filters.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

- A. Coordinate layout and installation of unit heaters and suspension system components

- B. Coordinate wall construction and conditions with recessed or semi-recessed cabinet unit heater installation requirements.

1.6 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. Cabinet Unit Heater Filters: Furnish (4) sets of spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corp.
 - 2. Trane
 - 3. McQuay
 - 4. Sterling
 - 5. Vulcan
 - 6. Modine
 - 7. Rittling

2.2 CABINET UNIT HEATERS

- A. Description: An assembly including filter, chassis, coil, fan, and motor in blow-through configuration with heating coil.
- B. Cabinet: For one or more of the following configurations:
 - 1. Concealed ducted unit: front and rear openings.
- C. Chassis: Galvanized steel, with flanged edges and unit-leveling bolts.
- D. Coil Section Insulation: 1-inch duct liner complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916. Fire-Hazard Classification: Duct liner and adhesive shall have a maximum flame-spread rating of 25 and smoke-developed rating of 50 when tested according to ASTM E 84.
- E. Cabinet: Galvanized steel, with removable panels.
- F. Cabinet Finish: Cabinet parts and exposed recessed panels shall be cleaned, bonderized, phosphatized, and painted with a baked powder finish available in six colors. Finish shall meet ASTM B117 specifications (salt spray test).

- G. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and with manual air vent. Coils shall be rated for a minimum working pressure of 300 psig and a maximum entering water temperature of 275 deg F, with manual air vent.
- H. Filters: 1-inch- thick, pleated glass-fiber media in fiberboard frame, Farr 30/30 Pleated Panel Air Filter or equivalent.
- I. Fan: Centrifugal, with forward-curved, double-width wheels and fan scrolls made of galvanized steel or thermoplastic material; directly connected to motor.
- J. Motors shall be brushless DC (BLDC)/electronically commutated motors (ECM) factory-programmed and run-tested in assembled units. The motor controller shall be mounted in a touch-safe control box with a built-in integrated user interface and LED tachometer. If adjustments are needed, motor parameters can be adjusted through momentary contact switches accessible without factory service personnel on the motor control board. Motors shall soft-ramp between speeds to lessen the acoustics due to sudden speed changes. Motors shall be operated at three speeds. The motor will choose the highest speed if there are simultaneous/conflicting speed requests. Motors shall have integral thermal overload protection with a maximum ambient operating temperature of 104°F and shall be permanently lubricated. Motors shall be capable of starting at 50 percent of rated voltage and operating at 90 percent of rated voltage on all speed settings. Motors shall operate up to 10 percent over voltage.
- K. Accessories
 - 1. Steel recessing flanges for recessing cabinet unit heaters into ceiling or wall.
 - 2. Tamperproof locks.
 - 3. Control Devices: Unit-mounted fan-speed switch and line voltage wall-mounting thermostat.
 - 4. Provide a unit-mounted disconnect switch.

2.3 UNIT HEATERS

- A. Description: An assembly including casing, coil, fan, and motor in the following configurations as scheduled:
 - 1. Sterling horizontal discharge configuration with horizontal, adjustable louvers in blow-through configuration.
- B. Casing: Galvanized steel, with removable panels.
- C. Cabinet Finish: Bonderize, phosphatized, and flow-coat with baked-on primer and manufacturer's standard paint applied to factory-assembled and -tested propeller unit heater before shipping.
- D. Hot-Water Coil: Copper tube, 0.031-inch wall thickness, 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 325 deg F, with manual air vent. Test for leaks to 375 psig underwater.
- E. Propeller with aluminum blades directly connected to motor.

- F. Fan Motors: shaded-pole or permanent-split capacitor, with integral thermal-overload protection.
- G. Units mounted shall be equipped with an OSHA fan guard. Fan guards shall be welded steel, zinc plated or painted.
- H. Accessories
 - 1. Horizontal Configuration: horizontal louvers.
 - 2. Control Devices: Unit-mounted fan-speed switch and line voltage wall-mounting thermostat.
 - 3. Provide a unit-mounted disconnect switch.

2.4 SOURCE QUALITY CONTROL

- A. Test unit heater coils according to ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to 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.

3.2 INSTALLATION

- A. Install unit heaters level and plumb.
- B. Install unit heaters to comply with NFPA 90A.
- C. Hung unit heaters shall be suspended from structure with rubber-in-shear vibration isolators (rubber hangers).

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Unless otherwise indicated, install shutoff valve and union or flange at each connection.

- C. Install piping adjacent to machine to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing and report results in writing:
 - 1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties.
- B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.5 CLEANING

- A. After installing units, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. After installing units, clean unit heaters internally according to manufacturers written instructions.
- C. Install new filters in each cabinet unit heater within two weeks after Substantial Completion.

END OF SECTION 238239

SECTION 238239.16 -ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes propeller unit heaters with electric-resistance heating coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. 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, using input from installers of the items involved:

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. INDEECO or equal.

2.2 DESCRIPTION

- A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 2021.
- D. Comply with UL 823.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
 - 1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.6 FAN AND MOTOR

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.7 CONTROLS

- A. Control Devices:
 - 1. Wall-mounted thermostat.

2.8 CAPACITIES AND CHARACTERISTICS

- A. Electric Coil:
 - 1. Capacities and electrical requirements as scheduled on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Install propeller unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Piping installation requirements are specified in the following Sections:
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Units will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

END OF SECTION 238239.16

SECTION 238316 - RADIANT- HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Radiant floor heating and control strategies, using cross-linked polyethylene (PEX) tubing and appropriate fittings.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications for snow melt piping including, dimensions, temperature capacities (both constant and intermittent), pressure ratings (both operating and burst), material composition and bend radius.
- B. Shop Drawings – Hydronic System
 1. Provide engineering analysis using manufacturer's proprietary software.
 2. Provide installation drawings indicating tubing layout, manifold locations, zoning requirements, and manifold schedules with details required for installation of the system.
 3. Provide mechanical schematic indicating heat source, mechanical piping and accessories from heat source to manifolds, circulators, water tempering, and zone controls. Indicate supply water temperatures and flow rates to manifolds.
- C. Piping Design Printout: Submit the following design information for each zone:
 1. Material list.
 2. Individual zone square footage with recommended tubing spacing and high intensity heating square footage.
 3. Heating intensity Btu/hr/sf
 4. The required heat input based on cross sections, including back and edge loss.
 5. GPM, TDH, and temperature differential.
 6. Tube type, length, diameter and number of circuits.
 7. Assumption Reports showing Conductivity of all material tubing to be installed in as well as finished surface thickness and Conductivity of same
- D. Warranty: Manufacturer's written warrantee.

E. Closeout Submittals:

1. Operation and maintenance data.
2. Final as-built tubing layout drawing.
3. Pressure test data.

1.4 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1. Store tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
2. Do not expose tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall have a minimum of ten years of experience in similar systems.
2. Manufacturer shall provide products of consistent quality in appearance and physical properties.
3. Manufacturer shall use the highest quality products in the production of systems and components referenced in this document.
4. Materials shall be from a single manufacturer to ensure consistent quality and compatibility.

B. Installer Qualifications:

1. Use and installer with demonstrated experience on projects of similar size and complexity and/or documentation proving successful completion of familiarization training hosted/approved in writing by the system manufacturer.
2. Electrical rough-in and connections shall be done by a licensed electrician.

C. Certifications: Provide letters of certification as follows:

1. Installer employs skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades-person.

- D. Regulatory Requirements and Approvals – Hydronic Systems: Provide a radiant system that complies with the following requirements:
1. International Mechanical Code (IMC)
 2. International Building Code (IBC)
 3. ICC Evaluation Service (ES) Evaluation Report No. ESR 1155
 4. Uniform Mechanical Code (UMC)
- E. Pre-installation meetings
1. Verify project requirements, substrate conditions, excavation conditions, system performance requirements, coverings, manufacturer's installation instructions, and warranty requirements.
 2. Review project construction timeline to ensure compliance or discuss modifications as required.
 3. Coordinate with other trade representatives to verify areas of responsibility.
 4. Establish the frequency (during construction phase of the project) the engineer intends for site visits and inspections by the manufacturer's representative.

1.6 SYSTEM START-UP

- A. Do not start the system for a minimum of 25 days or as specified by mortar, concrete and/or covering manufacturer as applicable.
- B. Verify all electrical components are installed per local and National Electrical Code (NEC) prior to start-up.

1.7 WARRANTY

- A. Manufacturer's Warranty – Hydronic Systems
1. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.
 2. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
 - a. Warranty covers the repair or replacement of any tubing or fittings proven defective.
 - b. Warranty may transfer to subsequent owners.
 - c. Warranty Period for Tubing is 25-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.
 - d. Warranty Period for Manifolds and Fittings is 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.
 - e. Warranty period for Controls and Electrical components is a 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Watts Radiant (Basis of Design)
 2. Uponor
 3. Rehau
 4. Viega
- B. Performance Requirements: **Provide a complete engineered system** – radiant heating and hydronic snow and ice melting system. System shall be designed, manufactured and installed to meet or exceed the performance criteria indicated in the contract documents. The system design and layout shall be performed by the manufacturer. The manufacturer shall have a minimum 5 years design and installation experience with projects similar in size and type.

2.2 PEX PIPE AND FITTINGS

- A. Material:
1. Cross-linked polyethylene (PEX)
 2. Manufactured by PEX-b or Silane method to ensure the highest level of oxidation protection.
- B. Material Standard:
1. Manufactured in accordance with ASTM F876 and ASTM F877
 2. Tested for compliance by an independent third-party agency.
- C. Pressure Ratings:
1. Standard Grade hydrostatic design
 2. Pressure ratings as issued by the Plastics Pipe Institute (PPI), a division of the Society of the Plastics Industry (SPI).
- D. Temperature/Pressure Ratings: shall be capable of withstanding temperatures of:
1. 73.4°F (23°C) at 160 psi (1.10 MPa)
 2. 180°F (82.2°C) at 100 psi (0.69 MPa)
 3. 200°F (93.3°C) at 80 psi (0.55 MPa).
- E. Minimum Bend Radius (Cold Bending):
1. No less than six times the outside diameter.
 2. Use the tubing manufacturer's bend supports if radius is less than stated.

F. Barrier Tubing Type Basis of Design : Watts Radiant RadiantPEX+

1. Oxygen Diffusion Barrier

- a. Tubing has an oxygen diffusion barrier that shall not exceed an oxygen diffusion rate of 0.10 g/cubic meter (.000062 lb/cu. ft.) per day at 104 degrees F (40 degrees C) water temperature in accordance with German DIN 4726.
- b. Tubing also adds a protective polypropylene layer to the outside of the EVOH barrier.

2. Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated:

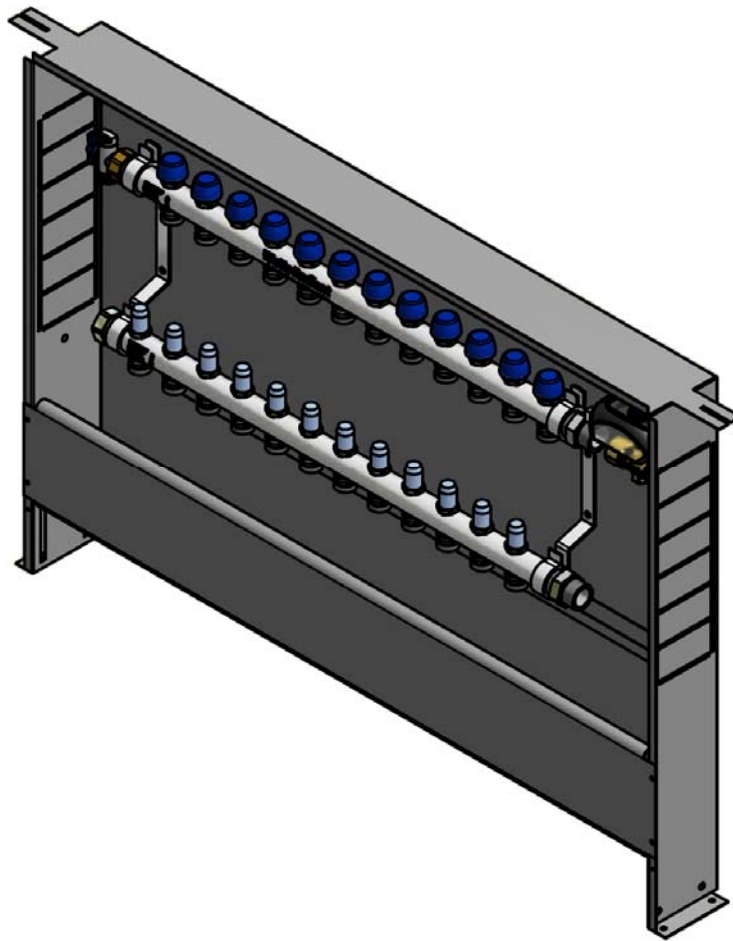
- a. 3/8 inch (9.53 mm)
- b. 1/2 inch (12.7 mm)
- c. 5/8 inch (15.88 mm)
- d. 3/4 inch (19.05 mm)
- e. 1 inch (25.4 mm)

2.3 MANIFOLDS

- A. For system compatibility, use 1 or 1½” Heavy-duty, DIN Standard, 304 Stainless Steel manifolds offered by the respective tubing manufacturer.
- B. Manifolds shall provide individual flow control for each loop of the manifold through valve actuators available from the manifold supplier.
- C. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
- D. Manifolds shall feature internal balancing valves for manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold. Balance valves shall not be ball valves.
- E. Each manifold location shall have the ability to vent air manually from the system.
- F. Stainless Steel Manifolds
 - 1. Heavy-duty, DIN Standard, 304 stainless steel
 - 2. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
 - 3. Internal balancing valves
 - 4. Flow meters
 - 5. Manifold brackets
 - 6. 2½” OC circuit spacing
 - 7. 194°F maximum operating temperature
 - 8. 87 psi maximum operating pressure

G. Manifold Mounting Boxes

1. Sizes – Watts Radiant manifold mounting boxes come in 3 sizes, provide correct size for application.
2. Each box shall be designed to be recessed into a 4" or 6" stud wall, coordinate with proper sizing. Included elevators can raise the box from 1½" to 4½" off of the floor.
3. Each manifold box is constructed of powder-coated sheet metal, providing increased resistance to corrosion and job-site abuse.
4. Inside Manifold Mounting Brackets: Provide suitable brackets.



2.4 FITTINGS

- A. For system compatibility, use fittings offered by the tubing manufacturer.
- B. The fitting assembly shall comply with ASTM F877 and CAN/CSA B137.5 requirements.

- C. Fittings shall be designed to work with either ASTM F1807 CrimpRings or ASTM F2098 CinchClamps or a Compression ferrule, and are designed to be used with ASTM F876 (SDR-9) rated PEX tubing.

2.5 ACCESSORIES

- A. Provide accessories associated with the installation of the radiant heating system as recommended by or available from the tubing manufacturer
- B. In slab on grade construction, tubing shall be secured to steel rebar every 3 feet (minimum) with plastic TEI wrap. Tie wrap ends shall be cut close to securing loop and discarded outside of pour area.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive radiant heating piping for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure that surfaces and pipes in contact with radiant heating piping are free of burrs and sharp protrusions.
 - 2. Ensure that surfaces and substrates are level and plumb.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

- 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 Shop or Coordination Drawings.
- B. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings.
- C. Install radiant heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
- D. Connect radiant piping to manifold in a reverse-return arrangement.
- E. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
- F. Install piping downstream from manifolds without any joints within the tubing loop. No tubing pieces shorter than the required loop length shall be used. Install full length tubing for every loop as designed.

- G. Tubing system shall be installed as designed and submitted by the manufacturer. Contractor shall not increase or decrease number of loops or length of loops.
- H. All tubing loops shall be clearly field marked with permanent marker as to their loop number on supply and return ends. These markings shall allow identification of loops from manifold location.
- I. Tubing shall be provided with markings every 3 feet by manufacturer. Contractor shall record length of each loop by manufacturer's markings at supply and return of loop.
- J. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Division 08.
- K. Slab temperature sensors must be removable, install in a pex tubing conduit.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Hanger, support, and anchor devices are specified in Division 22 Section "Hangers and Supports."
- B. Provide hangers per manufacturer's instructions.

3.4 INSTALLATION OF FLOOR HEATING SYSTEMS

- A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following:
 - 1. Installation manuals
 - 2. Design software engineering and analysis
- B. In Slab Installation:
 - 1. Fasten the tubing to the flat mesh or reinforcing bar in accordance with the tubing manufacturer's installation recommendations. Coordinate with Division 3 for 1st floor at grade and 2nd floor slab reinforcement methods.
 - 2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall as determined by manufacturer analysis.
 - 3. Staple the tubing to the insulation board.
 - 4. Install edge insulation where the heated panel directly contacts an exterior wall or panel.
 - 5. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.
 - 6. Where tubing crosses metal expansion joints in the concrete, ensure the tubing passes below the joints or is sleeved through the joint.
- C. Where tubing passes in and out of the slab for expansion, tubing shall be protected with Armaflex insulation. Insulation shall be 1" thick for a length of 6" in and 6" out of the concrete slab to avoid expansion chafing.

3.5 FIELD QUALITY CONTROL

A. Prepare piping for testing as follows:

1. Tubing shall not be tested until all loops in each snowmelt section to be tested are completed and in place. Test shall be conducted with tubing made up to manifolds as a complete assembly. Gauges shall be placed on the supply and return manifolds as needed for pressure testing of complete piping system.
2. Before any tubing, manifold or any part of the system is covered, perform a pressure test as follows and as required by the tubing manufacturer for warranty coverage.
3. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig.
4. After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
5. At the end of 24 hours, have pressure test gauges re-inspected by manufacturer's representative or owner's representative. If pressure has dropped by more than 5 psig, test shall be repeated after all leaks have been identified and repaired.
6. System shall be left in a pressurized state until tubing has been covered with concrete or other materials as specified. Contractor shall monitor pressure to be certain no tubing or component has been damaged or system has lost integrity during the pour.
7. Any field repairs to tubing that are required during the pour shall be done with a manufacturer provided coupling or fitting. Cut out damaged section of tubing for at least 1" on both sides of damaged section. After installing repair fitting, re-pressurize system to verify repair joint integrity. After testing is satisfactory, wrap fitting in electrical tape over all metal surfaces. Install a sleeve of Armaflex insulation over wrapped fitting, and secure with tape to prevent any exposure of metal components to concrete or backfill materials.

3.6 ADJUSTING

- A. System shall be filled with glycol and manually vented at each manifold before any adjustments are made. System pumps shall be activated and run to eliminate all air from loops before adjustments.
- B. Balancing across the manifold for equal flow resistance based on actual loop lengths and total manifold flow.

3.7 DEMONSTRATION

- A. Demonstrate operation of hydronic snow and ice melting systems to Owner's personnel.
- B. Instruct the owner's representative about the type and concentration of glycol/water solution used in the hydronic snow and ice melting system.
- C. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.8 FIELD SERVICES

- A. Contractor shall provide the services of a manufacturer's authorized representative for requirements outline in this specification section.
- B. Factory representative shall familiarize contractor with all specific requirements and manufacturer's instruction for the proper and warranted installation of snowmelt system.
- C. Representative shall inspect and review all aspects of snowmelt systems installation. Representative shall provide supervision of system startup services at the project.

END OF SECTION 238316

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade walks pavements and exterior plants.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase and base course for concrete walks.
 - 5. Subbase and base course for asphalt paving.
 - 6. Subsurface drainage backfill for walls and trenches.
 - 7. Excavating and backfilling for utility trenches within the building excavation limits.
 - 8. Excavating and backfilling for site utility trenches.
 - 9. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
 - 10. Provision, transportation and placement of all required fill and backfill materials.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet in width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 2 cu. yd. for bulk excavation or 1 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course.

K. Subgrade: Uppermost surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Geotextile fabrics.

B. Samples:

1. 12-by-12-inch Sample of geotextile.

- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D 1557 for each on-site and borrow soil material proposed for fill and backfill.
- D. Blasting Plan: For record purposes; approved by authorities having jurisdiction.
- E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.5 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
 - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
 - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- C. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
- D. Earthwork Observation and Testing:
 - 1. The owner and/or owner's agent will retain a qualified Geotechnical Engineer and/or testing agency to perform onsite observation and testing during work under this and related sections and as indicated in the "Schedule of Special Inspections." The services of the geotechnical engineer/testing agency may include, but not be limited to, the following:
 - a. Observation during excavation, subgrade preparation and backfill for footings, slabs-on-grade, and subsurface drainage construction, etc.

- b. Determination of requirements for additional excavation to remove unsuitable materials.
 - c. Observation and testing during placement and compaction of fill and backfill.
 - d. Laboratory testing and analysis of fill materials specified.
 - e. Review of submittals.
2. During the course of construction the Geotechnical Engineer/testing agency shall advise the owner's agent, in writing, with a copy to the Architect and Contractor, if at any time, in his opinion, the work is not in substantial conformity with the plans and specifications. The Geotechnical Engineer's and/or testing agency's presence does not include supervision of direction of the actual work by the Contractor, his employees, subcontractors or agents. Neither the presence of the geotechnical engineer and/or testing agency, nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.
 3. Testing equipment will be provided by and testing performed by the Geotechnical Engineer and/or testing agency, except as otherwise provided by contract. Upon request by the owner's agent, the Contractor shall provide such auxiliary personnel and services as needed to accomplish testing work and to repair damage caused thereby to permanent work.
 4. References herein to observations, testing and determinations by the "Engineer" include services to be provided by the Geotechnical Engineer and/or testing agency when appropriate and when so authorized by the engineer or owner.
- E. Pre-excavation Conference: Conduct conference at Project site.
1. Before commencing earthwork, meet with representatives of the governing authorities, owner, architect, engineer, consultants, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Existing Utilities:
1. Notify utility locator service for area where project is located before site clearing or excavating. Contact Dig Safe not less than 3 business days before starting the work. Dig Safe requirements are in addition to local and/or State DOT street opening permit requirements

2. Hire private utility markout service for areas not marked by utility companies. See the "General Conditions" of the construction contract.
 3. Before starting excavation, establish location and extent of any underground utilities occurring in work area. Make arrangements with appropriate utility company for removal and relocation of lines which are in the way of excavation. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
 4. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for direction. Cooperate with owner, owner's agent, and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
 5. Inactive or abandoned utilities encountered during construction operations shall be removed, plugged or capped. The location of such utilities shall be noted on record drawings and reported in writing to owner's agent. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff services if lines are active.
 6. Do not interrupt existing utilities serving facilities occupied and used by owner or others, during occupied hours, except when permitted in writing by owner's agency and then only after arranging to provided acceptable temporary utility services. Provide minimum of 48 hour notice to owner's agent and receive written notice to proceed before interrupting any utility. Do not proceed with utility interruptions without owner's written permission.
 7. When in the course of the work it is necessary to connect a utility to a main in a public way, all the requirements of both the authorities governing the utility and those governing the public way shall be met. Pavement shall be temporarily and permanently replaced as directed by these authorities at no additional cost to the owner.
- C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS - GENERAL

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
 2. Unsuitable Materials also include material containing excessive plastic clay, vegetation, organic matter, debris, pavement, stones or boulders over 6 inches in greatest dimension,

and frozen material. Material which, in the opinion of the Geotechnical Engineer, will not provide a suitable foundation or subgrade.

- D. On-Site Material: Any suitable material from on-site excavation.
- E. Common Borrow: Inorganic mineral soil suitable for embankment construction free from frozen material, perishable rubble, peat and other unsuitable material.
- F. Backfill and Fill: Satisfactory soil materials.
- G. Unless indicated otherwise, materials shall conform to the "Standard Specification for Highways and Bridges" revision of December 2014, Maine Department of Transportation (abbreviated as MDOT "Standard Specification").
- H. General Fill: Clean, sound mixture of material free of debris, waste, frozen materials and organics with 5 inch maximum size aggregate and not more than 12 percent passing the No. 200 sieve.

2.2 SOIL MATERIALS FOR ROADWAYS AND PARKING LOTS

- A. Aggregate Subbase Material: Shall meet the requirements of Maine Department of Transportation Standard Specifications Section 703.06(b), Type D.
- B. Aggregate Base Materials: Shall meet the requirements of MDOT Standard Specifications Section 703.06(a), Type A, Section 703.06(a), Type B as indicated.

2.3 SOIL MATERIALS FOR STRUCTURES

- A. Foundation Backfill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand which are free from vegetable matter, lumps, or balls of clay, and other deleterious substances with no particles of rock that will not pass the 3-in. square mesh sieve. The gradation of the portion which will pass a 3-inch sieve shall meet the grading requirements of the following table:

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
3 inch	100
1/4 inch	25-100
No. 40	0-50
No. 200	0-6

- B. Structural Fill (under concrete slabs): Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand which are free from vegetable matter, lumps, or balls of clay, and other deleterious substances with no particles of rock that will not pass the 3-in. square mesh sieve. The gradation of the portion which will pass a 3-inch sieve shall meet the grading requirements of the following table:

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
3 inch	100
1/2 inch	35-80
1/4 inch	25-65
No. 40	0-30
No. 200	0-7

- A. 3/4 Inch Crushed Stone (under footings): Crushed stone shall be a quarry product 3/4 inch or washed gravel stone obtained from offsite sources for use as detailed on the drawings. Crushed stone shall consist of durable crushed rock or gravel stone essentially free of silt, clay, loam or other deleterious materials and shall conform to the following gradation requirements for the nominal size indicated.

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
1 inch	100
3/4 inch	90-100
1/2 inch	20-55
3/8 inch	0-15
No. 4	0-5

2.4 PIPE BEDDING MATERIALS

- A. Sand: ASTM C 33; fine aggregate.
- B. 3/4 Inch Crushed Stone: Crushed stone shall be a quarry product 3/4 inch or washed gravel stone obtained from offsite sources for use as detailed on the drawings. Crushed stone shall consist of durable crushed rock or gravel stone essentially free of silt, clay, loam or other deleterious materials and shall conform to the following gradation requirements for the nominal size indicated.

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
1 inch	100
3/4 inch	90-100
1/2 inch	20-55
3/8 inch	0-15
No. 4	0-5

2.5 GEOTEXTILES

- A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Basis-of-Design Product: Mirafi 600X by Mirafi Inc., P.O. Box 240697, Charlotte, North Carolina 28224.
 2. Survivability: Class 2; AASHTO M 288.
 3. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 4. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 5. Tear Strength: 90 lbf; ASTM D 4533.
 6. Puncture Strength: 90 lbf; ASTM D 4833.
 7. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 8. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 9. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.6 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Prepare subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.
- C. Protect and maintain erosion and sedimentation controls, which are specified on the drawings.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

- E. Paved surfaces: Do not operate equipment on paved surfaces that will damage surface.
- F. Preparation of Building Area for Foundations:
 - 1. The Contractor's bid is to include the costs to excavate and legally dispose of from the site all materials within the building footprint to the subgrade elevations indicated on the drawings, including stripping of topsoil. The Contractor's bid is also to include all excavation of the area of proposed footings plus 2 feet horizontally (minimum) beyond the area of all footings as well as excavation of necessary transitional slopes per OSHA requirements, and backfill with compacted granular fill. The Contractor's bid is to include the removal of all previous construction including foundations, walls, slabs and abandoned utilities from within the limits of the proposed building. Additionally the Contractor's bid is to include the costs to furnish and place compacted granular fill and base materials to the slab subgrade elevations indicated on the drawings.
 - 2. Excavation of Unsuitable Material within the Influence of the Building Foundations: Additional excavation to remove existing fill or other unsuitable material from within the areas of influence of the foundations and below slabs-on-grade shall be conducted when so directed by the Geotechnical Engineer. The horizontal limits of excavation below footing level shall be one foot beyond the outside perimeter of the footing plus an additional one foot for every foot of depth below the footing, unless otherwise directed by the engineer.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. The Contractor shall grade and ditch the site as necessary to direct surface runoff away from open excavations.
 - 2. The Contractor shall provide, at his own expense, adequate pumping and drainage facilities to keep all excavations and work sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction product or procedures nor cause excessive disturbance of underlying natural ground or footing and slab subgrades. Contractor shall similarly control water entering the excavation as a result of construction operations, such as washing of concrete equipment and tools and the like.
 - 3. Water from trenches and excavations shall be disposed of in such a manner as will not cause injury to public health, nor damage to public or private property, existing work, or work in progress, nor to the surface of roads, walks and streets, nor cause any undue interference with the use of the same by the public. The Contractor shall comply with all applicable environmental protection and/or sediment/erosion control regulations.
 - 4. Under no circumstances place concrete or fill, or lay piping or install appurtenances in excavations containing free water. Keep utility trenches free from water until pipe joint material has hardened.

3.3 SHEETING, SHORING AND BRACING

- A. Provide sheeting, shoring and/or bracing at excavations as required to assure safety against collapse of earth or rock at sides of excavations; as required for support of adjacent structures, streets or utilities; or as required to comply with federal, state or local regulations, codes or ordinances.
- B. Provide materials for sheeting, shoring and bracing, such as sheet piling, uprights, stringers and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down sheeting, shoring and bracing as excavation progresses.
- C. All sheeting and bracing not ordered left in place shall be carefully removed in such a manner as not to endanger the construction of other structures, utilities or property whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand and rammed with tools especially adapted to that purpose or otherwise compacted as directed to achieve the required density.
- D. Wood sheeting shall not be completely withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than one foot above the top of pipe.

3.4 EXPLOSIVES

- A. Not applicable.

3.5 EXCAVATION, GENERAL

- A. Stability of Excavations:
 - 1. Slope sides of excavations to comply with OSHA regulations and local codes. Shore and brace where sloping is not possible because of space restrictions or stability to material excavated.
 - 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- B. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include soil materials, and obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials, replace with satisfactory soil materials.

3.6 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Spread Footing Subgrades:
1. Spread footing foundations shall bear on natural inorganic soil or compacted crushed stone overlying natural inorganic soils. The compacted crushed stone shall extend at least one foot horizontally beyond the limits of the footing.
 2. Footing subgrades shall be prepared by excavating all existing material to the specified bottom of the footing elevation, 5 feet below existing grades, or as indicated on the Contract Documents, whichever is lower. Allow the geotechnical engineer to view the excavated subgrade at this level. The geotechnical engineer shall determine whether authorized additional excavation is required to remove unsuitable material. Remove and replace such unsuitable material in accordance with paragraph 3.05 B.2 of this section or as otherwise directed by the engineer.
 3. The Contractor shall take every precaution to minimize the disturbance of excavated subgrades in the natural soils. Such precautions shall include, but not be limited to, using excavation buckets without teeth and/or accomplishing excavation to final subgrade with hand tools. All materials disturbed during excavation shall be removed to undisturbed natural soils or re-compacted as directed by the engineer.
 4. Refill excavation to the specified bottom of the footing elevation with crushed stone placed and compacted in accordance with the requirements of this Section.
 5. Proof compact the final footing subgrade with at least two passes of a vibratory plate compactor immediately prior to placing forms and reinforcing.
- C. Subgrade for Slabs-on- Grade:
1. Slabs-on- grade shall be supported on subbase/base courses as indicated on the drawings.
 2. Remove and replace excessively wet, disturbed or unstable material and proof compact the subgrade for the slab subbase/base course with at least six passes of a vibratory plate or vibratory roller compactor immediately prior to placement of slab base course material unless otherwise directed.
 3. The final surface of the subgrade for the moisture retarder membrane and/or slabs-on- grade shall be proof rolled with at least four passes of an approved vibratory plate or vibratory drum compactor immediately prior to placing the membrane, reinforcing or concrete (as may be applicable).

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.
- B. Saw cut pavement prior to excavation to provide a clean, uniform edge. Minimize disturbance of remaining pavement. Cut and remove the minimum amount of pavement required to do the work.
- C. Use shoring and bracing where sides of excavation will not stand without undermining pavement.

3.8 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: 9 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.9 SUBGRADE INSPECTION

- A. Notify Architect, Geotechnical Engineer and Owner's agent when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed and in accordance with Article "Excavation for Structures" of this section.

- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized Additional Excavation: In the case that unsuitable materials, as determined by the engineer, are encountered at the specified subgrade elevation, the engineer may direct the removal of the unsuitable material and refill with granular fill placed and compacted in accordance with the requirements of this Section. This work will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Unauthorized Excavation: Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the engineer or owner's agent. Unauthorized excavation, as well as remedial work specified by the engineer, shall be at the Contractor's expense.
 - 1. In areas below structures, pavements and walks, backfill unauthorized excavation with granular fill placed and compacted in accordance with this Section, unless otherwise directed by the engineer.
 - 2. Elsewhere, backfill and compact unauthorized excavations with general fill, compacted to the requirements of this Section.
 - 3. Where the excavation of otherwise suitable materials is required due to these materials being rendered unsuitable due to disturbance, construction activity, freezing or lack of protection from the elements, the Contractor shall excavate these materials and provide remedial work as specified above at no additional cost to the owner.
- B. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

- A. Backfilling Prior to Acceptance of Work Installed:
 - 1. Do not allow or cause the work performed or installed to be covered up or enclosed by work of this Section prior to all required inspections, tests and acceptances.
 - 2. Should any of the work be so enclosed or covered up before it has been accepted, uncover all such work at no additional cost to the owner.
 - 3. After the work has been completed, tested, inspected and accepted, make all repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, all at no additional cost to the owner.
- B. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- C. Place backfill on subgrades free of mud, frost, snow, or ice.
- D. Unless otherwise specified or indicated on the drawings, the products specified in Part 2 of this Section shall be employed in the various fill and backfill applications indicated in that part. Place and compact fill material in layers to required elevations as follows:
 - 1. Under steps and ramps, use granular fill material.
 - 2. Under building slabs-on-grade, use granular fill, crushed stone and sand-gravel material. See Contract Documents for additional information.
 - 3. Under footings and foundations, use granular fill.
 - 4. Against the interior face of foundation walls, use granular fill material. Use granular fill material to 3'-0" beyond the outside face of foundation walls. Use general fill beyond the 3 feet of granular fill.
 - 5. Against the interior face (retained soil side) of site retaining walls use granular fill material. Use granular fill material to 3'-0" beyond the inside (retained soil side) of site retaining walls. Use general fill beyond the 3 feet of granular fill.
 - 6. Under utilities, use either bedding material or crushed stone (see drawings).

7. Under equipment pads, use crushed stone.
 8. Under grass and planted areas, use general fill
 9. Under walks and pavements, use base and subbase material
- E. All vegetation, peat, organic topsoil or subsoil, trash, debris, roots, stumps, and any compressible or otherwise deleterious materials shall be stripped from the existing ground surface and removed from excavations prior to placement of fill or backfill.
- F. All fill and backfill materials shall be placed in horizontal layers. Each layer shall be spread evenly and thoroughly mixed during spreading to ensure uniformity of material in each layer. Layer thickness shall not exceed that specified elsewhere in this Section.
- G. Where horizontal fill layers meet a natural or excavated slope, the layer shall be keyed into the slope by cutting a bench. The surface of benches shall be compacted to the same requirements as apply to the area being filled.
- H. In no instance place fill over materials that were permitted to freeze prior to compaction or over ice or snow. Removal of such materials will be required as directed by the engineer. In no case will frozen material be allowed for use in fill or backfill.
- I. No fill shall be placed or compacted during unfavorable weather conditions. When work is interrupted by heavy rains or snow, fill operations shall not be resumed until the moisture content and density of previously placed fill are as specified hereinafter.

3.13 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."
- D. Backfill under all existing utility pipes crossed during construction operations with 3/4-inch crushed stone. Crushed stone backfill shall extend continuously from the bedding of new utility pipes to the utility pipe crossed, including a 6-inch thick envelope of crushed stone all around the existing utility pipes. Crushed stone backfill shall stand at its own angle of repose. No "haunching" or "forming" with common fill will be allowed.
- E. Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- F. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Electrical and Telecommunications Conduit:

1. Electrical Conduits: Bury beneath finish grade a minimum of 30 inches to top of conduit, or as required by the National Electrical Code or local utility company, whichever is deeper. Surround conduits by a minimum of 6 inches of sand or bedding material.
2. Telephone and Communication Conduits: Bury beneath finish grade a minimum of 30 inches to top of conduit, or as required by the local utility company, whichever is deeper. Surround conduits by a minimum of 6 inches of sand or bedding material.

H. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

I. Place and compact final backfill of satisfactory soil to final subgrade elevation.

J. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

K. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

L. Coordinate backfilling with utilities testing.

3.14 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

B. Moisture Control:

1. Water shall be added to fill material which does not contain sufficient moisture to be compacted to the specified densities. Fill and backfill material containing excess moisture shall be required to dry prior to or during compaction to a moisture content not greater than two percentage points above optimum except that material which displays pronounced elasticity or deformation underfoot or under load shall be required to dry to optimum moisture content before it is placed and compacted, if that is required to achieve specified compaction. At the Contractor's option, material which is too wet may be removed and replaced with satisfactory material at no additional cost to the owner.
2. The Contractor is alerted to the potential silty nature of the onsite soil which renders them sensitive to moisture. Onsite silty soils are difficult to handle and compact and are easily disturbed when wet. The Contractor shall plan and conduct his excavation and filling operations considering the nature of the onsite materials.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Allow the geotechnical engineer sufficient time to make necessary observations and tests. The degree of compaction shall be based on a maximum dry density as determined by ASTM Standard D1557. All fill and backfill placed in various areas shall be compacted in individual layers to minimum dry densities as follows:
 1. Under Structures, within Building Foundation Backfill Limits, Equipment Pads, Building Slabs, Steps and Pavements: 95 percent.
 2. Beside site retaining walls or tank walls: 95 percent
 3. Top 2 feet under pavement: 95 percent
 4. Below top 2 feet under pavement: 92 percent
 5. Trenches through paved areas, top 2 feet:: 95 percent
 6. Trenches through paved areas, below top 2 feet: 92 percent
 7. Trenches through unpaved areas: 92 percent
 8. Embankments: 92 percent
 9. Pipe Bedding: 92 percent
 10. Under pipes through structural fills: 92 percent
 11. Underdrain filter sand: 92 percent
 12. Sand bedding for conduit: 95 percent

13. Grass and mulch areas: 90 percent
 14. Uniformly graded crushed stone materials which are not suited to field density testing shall be compacted in accordance with the minimum compactive effort indicated in paragraph 3.10 L of this Section.
- D. The term "under," as applied to building, structures and paved areas, shall be construed to include all materials immediately below the plan area of the building, as well as those materials within a line sloping at one vertical to one horizontal drawn downward and outward from the exterior of building foundation, structure foundation or paved area.
- E. Compaction shall be by mechanical means designed specifically for compaction and approved by the engineer. The engineer reserves the right to disapprove any device or inadequate capacity or of type unsuited to the character of the material being compacted. In areas which are too restricted to permit the use of mechanical compactors, fill may be placed in 3 inch layers and compacted by hand rammer or pneumatic tools.
- F. In addition to the stated degree of compaction, all fill and backfill shall receive at least the compactive effort given in the following table. Lift thickness shall not exceed that shown for the compaction method selected, except that the first lift of fill or backfill placed over natural ground in wet conditions may be as much as 12 inches thick. Application of the minimum compactive effort does not relieve the contractor from his requirement to achieve the specified degree of compaction.

Compaction Method	Maximum Stone Size	Maximum Loose Lift Thickness	Maximum Loose Lift Thickness	Minimum Number of Passes	Minimum Number of Passes
		Below Structures and Pavement	Less Critical Areas	Below Structures and Pavement	Less Critical Areas
Hand-operated vibratory plate or light roller in confined areas	3"	6"	8"	6	4
Hand-operated vibratory drum rollers weighting at least 1,000 lbs	6"	8"	10"	6	4
Hand-operated vibratory drum rollers weighting at least 3,000 lbs	6"	8"	14"	6	4
Hand-operated vibratory drum rollers weighting at least 5,000 lbs	6"	8"	18"	6	4
Hand-operated vibratory drum rollers weighting at	6"	8"	24"	6	4

least 8,000 lbs					
-----------------	--	--	--	--	--

- G. Where the engineer determines that fill or backfill does not conform to the compacted density specified, or did not receive the minimum compactive effort specified, such fill shall be removed and replaced with conforming materials at the Contractor's own cost.
- H. Backfilling of Walls:
 - 1. Do not backfill against walls until completion of slabs-on- grade, structural framing and suspended slabs which provide lateral support to these walls. In placing backfill, take special care to prevent any wedge action, eccentric loading or overloading by equipment used in backfilling and compaction. See Contract Documents for additional requirements.
 - 2. Do not use equipment weighing more than 5,000 lbs. within 10 feet of all walls. Equipment weighing more than 5,000 lbs. shall not be used adjacent to walls, except as expressly approved by the engineer.
 - 3. Backfill shall be placed concurrently on all sides of shafts, tunnel, and freestanding walls, each lift being compacted on all sides before successive lifts are placed. See Contract Documents for additional requirements.
 - 4. Prevent damage to wall waterproofing or dampproofing when backfilling.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1/2 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.
- D. Maintenance:
 - 1. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
 - 2. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.18 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer [**to 85 percent of maximum dry unit weight according to ASTM D 698**] [**with a minimum of two passes of a plate-type vibratory compactor**].
 - 2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade.
- D. Drainage Backfill for Site Retaining Walls: Place and compact granular fill material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each granular fill material layer to specified compaction of soil backfills and fills requirements.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES

- A. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Place base course material over subbase course under hot-mix asphalt pavement.
 - 2. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 3. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
 - 4. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 5. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.20 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.21 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, each soil stratum will be verified by a Geotechnical Engineer to confirm subgrade preparation and ability to support design bearing capacities.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
 - 1. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.
 - 2. When field in-place density tests are performed using nuclear methods, make calibration checks for both density and moisture gages at the beginning of work, on each different type of material encountered and at intervals as directed by the engineer.
 - 3. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

4. Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests along a wall face.
 5. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.
 6. Pavement areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
- B. If hazardous waste or special waste as defined by the U.S. Environmental Protection Agency or State Department of Environmental Protection is encountered during excavation, the Contractor shall avoid disturbance of that material, and shall notify the Engineer immediately. The State Bureau of Oil and Hazardous Waste Control shall be notified and consulted prior to disturbance of the waste or contaminated soil. Removal and disposal of contaminated materials is not included in the Contract, and will be paid for by appropriate change order.

END OF SECTION 312000

SECTION 316216 - STEEL PILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes steel H piles.

1.3 UNIT PRICES

- A. Contract Sum: Base Contract Sum on number and dimensions of piles indicated from tip to cutoff, plus not less than 12 inches of overlength for cutting piles at cutoff elevations.
- B. Work of this Section is affected as follows:
 - 1. Additional payment for pile lengths in excess of that indicated, and credit for pile lengths less than that indicated, is calculated at unit prices stated in the Contract, based on net addition or deduction to total pile length as determined by Architect and measured to nearest 12 inches.
 - 2. Unit prices include labor, materials, tools, equipment, and incidentals for furnishing, driving, cutting off, capping, and disposing of cutoffs.
 - 3. No payment is made for rejected piles, including piles driven out of tolerance, defective piles, or piles damaged during handling or driving.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For steel H piles. Show fabrication and installation details for piles, including details of driving points, splices, and pile caps.
 - 1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Welding certificates.
- C. Mill Test Reports: For steel H piles, steel castings and steel plate, signed by manufacturer.
- D. Pile-Driving Equipment Data: Include type, make, and rated energy range; weight of striking part of hammer; weight of drive cap; and, type, size, and properties of hammer cushion.
- E. Pile-Driving Records: Submit within three days of driving each pile.
- F. Certified Piles Survey: Submit within seven days of pile driving completion.
- G. Field quality-control reports.
- H. Preconstruction Photographs: Photographs or video of existing conditions of adjacent construction. Submit before the Work begins.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - 1. Installer's responsibility includes engaging a qualified professional engineer to prepare pile-driving records.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piles to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent buckling or physical damage.

1.9 FIELD CONDITIONS

- A. Protect structures, underground utilities, and other construction from damage caused by pile driving.
- B. Site Information: A geotechnical report has been prepared for this Project and is referenced elsewhere in the Project Manual for information only.

- C. Preconstruction Photographs: Inventory and record the condition of adjacent structures, underground utilities, and other construction. Document conditions that might be misconstrued as damage caused by pile driving. Comply with Section 013233 "Photographic Documentation."

PART 2 - PRODUCTS

2.1 STEEL H PILES

- A. High-Strength, Low-Alloy, Structural Steel: ASTM A 36, Grade 36.

2.2 PILE ACCESSORIES

- A. Driving Points: Manufacturer's standard one-piece driving point, fabricated from steel castings as follows to provide full bearing of web and flange of pile tip:
 - 1. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 65-35, heat treated.
- B. Splice Unit: Manufacturer's standard splice unit, fabricated from two connected steel plates, of same material as steel H pile or material of equal strength, shaped to encase web and part of each flange.

2.3 PAINT

- A. Paint: SSPC-Paint 16; self-priming, two-component, coal-tar epoxy polyamide, black.

2.4 FABRICATION

- A. Fabricate and assemble piles in shop to greatest extent possible.
- B. Pile-Length Markings: Mark each pile with horizontal lines at 12-inch intervals; label the distance from pile tip at 60-inch intervals. Maintain markings on piles until driven.
- C. Fabricate full-length piles to eliminate splicing during driving, with ends square.
- D. Fabricate full-length piles by splicing lengths of steel H pile together. Accurately mill meeting ends of piles and bevel for welding. Maintain axial alignment of pile lengths. Maintain structural properties of pile across splice.
 - 1. Continuously Welded Splices: Splice piles by continuously welding according to AWS D1.1/D1.1M for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 2. Splice piles during fabrication or field installation.
- E. Fit and weld driving points to tip of pile according to manufacturer's written instructions and AWS D1.1/D1.1M for procedures, appearance and quality of welds, and methods used in correcting welding work.

2.5 SHOP PAINTING

- A. General: Shop paint steel pile surfaces, except for surfaces to be encased in concrete, as follows:
 - 1. Extend painting to six inches into the bottom of pile cap .
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and loose mill scale, spatter, slag, and flux deposits. Prepare surfaces according to SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
- C. Painting: Immediately after surface preparation, apply coat of paint according to manufacturer's written instructions to provide a dry film thickness of not less than 8 mils.
 - 1. Apply second coat to provide a dry film thickness of not less than 8 mils, resulting in a two-coat paint system thickness of not less than 16 mils.
 - 2. Apply second and third coats with each coat having a dry film thickness of not less than 8 mils, resulting in a three-coat paint system thickness of not less than 24 mils.
 - 3. Mark pile lengths after shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Conditions: Do not start pile-driving operations until earthwork fills have been completed or excavations have reached an elevation of 6 to 12 inches above bottom of footing or pile cap.

3.2 DRIVING EQUIPMENT

- A. Pile Hammer: Air-, steam-, hydraulic-, or diesel-powered type capable of consistently delivering adequate peak-force duration and magnitude to develop the ultimate capacity required for type and size of pile driven and character of subsurface material anticipated.
- B. Hammer Cushions and Driving Caps: Between hammer and top of pile, provide hammer cushion and steel driving cap as recommended by hammer manufacturer and as required to drive pile without damage.
- C. Leads: Use fixed, semifixed, or hanging-type pile-driver leads that hold the full length of pile firmly in position and in axial alignment with hammer.

3.3 DRIVING PILES

- A. General: Continuously drive piles to elevations or penetration resistance indicated. Establish and maintain axial alignment of leads and piles before and during driving.
- B. Heaved Piles: Redrive heaved piles to tip elevation at least as deep as original tip elevation with a driving resistance at least as great as original driving resistance.

- C. Driving Tolerances: Drive piles without exceeding the following tolerances, measured at pile heads:
1. Location: 4 inches from location indicated after initial driving, and 6 inches after pile driving is completed.
 2. Plumb: Maintain 1 inch in 48 inches from vertical, or a maximum of 4 inches, measured when pile is aboveground in leads.
 3. Batter Angle: Maximum 1 inch in 48 inches from required angle, measured when pile is aboveground in leads.
- D. Withdraw damaged or defective piles and piles that exceed driving tolerances, and install new piles within driving tolerances.
1. Fill holes left by withdrawn piles using cohesionless soil material such as gravel, broken stone, and gravel-sand mixtures. Place and compact in lifts not exceeding 72 inches.
 2. Fill holes left by withdrawn piles as directed by Architect.
- E. Cut off tops of driven piles square with pile axis and at elevations indicated.
- F. Pile-Driving Records: Maintain accurate driving records for each pile, compiled and attested to by a qualified professional engineer. Include the following data:
1. Project name and number.
 2. Name of Contractor.
 3. Pile location in pile group and designation of pile group.
 4. Sequence of driving in pile group.
 5. Pile dimensions.
 6. Ground elevation.
 7. Elevation of tips after driving.
 8. Final tip and cutoff elevations of piles after driving pile group.
 9. Records of re-driving.
 10. Elevation of splices.
 11. Type, make, model, and rated energy of hammer.
 12. Weight and stroke of hammer.
 13. Type of pile-driving cap used.
 14. Cushion material and thickness.
 15. Actual stroke and blow rate of hammer.
 16. Pile-driving start and finish times, and total driving time.
 17. Time, pile-tip elevation, and reason for interruptions.
 18. Number of blows for every 12 inches of penetration, and number of blows per 1 inch for the last 6 inches of driving.
 19. Pile deviations from location and plumb.
 20. Preboring, jetting, or special procedures used.
 21. Unusual occurrences during pile driving.
- G. Certified Piles Survey: Engage a land surveyor to prepare a piles survey showing final location of piles in relation to the property survey and existing benchmarks.
1. Notify Architect when deviations from locations exceed allowable tolerances.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Pile foundations.
 - a. Concrete.
 - b. Rebar installation.
 - c. Column anchor bolt installations.
- B. Tests and Inspections:
 - 1. Weld Testing: In addition to visual inspection, welds shall be tested and inspected according to AWS D1.1/D1.1M and inspection procedures listed below, at testing agency's option. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Radiographic Inspection: ASTM E 94, minimum quality level "2-2T."
 - d. Ultrasonic Inspection: ASTM E 164.
- C. Steel H piles will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 TOUCHUP PAINTING

- A. Clean field welds, splices, and abraded painted areas and field-apply paint according to SSPC-PA 1. Use same paint and apply same number of coats as specified for shop painting.
 - 1. Apply touchup paint before driving piles to surfaces that are immersed or inaccessible after driving.

3.6 DISPOSAL

- A. Remove withdrawn piles and cutoff sections of piles from site, and legally dispose of them off Owner's property.

END OF SECTION 316216

SECTION 320000 - SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of site improvements.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and abandoning in-place site utilities as indicated.
4. Disconnecting, capping or sealing, and removing site utilities as indicated.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.2 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.

1.3 MATERIALS OWNERSHIP

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

1.4 SUBMITTALS

A. Schedule of Site Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping of utility services.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

- B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.6 PROJECT CONDITIONS

- A. Conduct site demolition so operations of adjacent occupied buildings will not be disrupted.
 - 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent buildings or facilities.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction and Owner's Representative.
- B. Owner assumes no responsibility for building structures and utilities to be demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 2. Before site demolition, Owner will remove wanted items.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered by the Contractor, do not disturb; immediately notify the Owner's Representative for review of situation and development of remedial action required.
- D. On-site storage of removed items or materials is not permitted without the permission of the Owner's Representative.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify that hazardous materials have been remediated before proceeding with site demolition operations.

3.2 PREPARATION

- A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings, structures, and utilities to be demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

- B. Existing Utilities: Refer to Divisions 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings at all times.

- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner's Representative and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner's Representative and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities and Controls."
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.

6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 DEMOLITION, GENERAL

- A. General: Demolish indicated existing site improvements completely or to the limits indicated on the drawings. Use methods required to complete the Work within limitations of governing regulations.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.
- D. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet (1.5 m) outside footprint indicated for new construction. Abandon below-grade construction outside this area.
1. Remove below-grade construction, including basements, foundation walls, and footings, to at least 12 inches (300 mm) below grade.
 2. Remove below-grade construction, including basements, foundation walls, and footings, to depths indicated.
- E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet (1.5 m) outside footprint indicated for new construction. Abandon utilities outside this area.
1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."
- F. Demolish and remove existing utilities and below-grade utility structures.

1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."

3.5 SITE RESTORATION

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with acceptable materials according to backfill requirements in Division 31 Section "Earth Moving."
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.6 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024113

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Asphalt surface treatments.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 1. Job Mix Designs: Contractor shall submit a mix design using either the “Marshall Stability” or “Superpave” Mix Design Submittal Forms, included in this specification, for each pavement course proposed for construction for the Owner’s review and approval 45 days prior to schedule production and placement of the mix.
 2. “Marshall Stability” design mix submittals shall include type/name of mix, gradation analysis, grade of asphalt cement, Marshall Stability in pounds flow, effective asphalt content in percent (%), and corresponding copies of the Maine Department of Transportation (MDOT) material specifications.
 3. “Superpave” design mix submittals may be submitted in lieu of a “Marshall Stability” design mix, meeting the specifications of the Maine Department of Transportation.
- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Material Certificates: Contractor shall submit certificates stating that asphalt mix to be supplied complies with the specifications of the Maine Department of Transportation, as well as copies

the regulatory specifications corresponding to the asphalt mix formula and material. The certificates shall be signed by the asphalt mix producer and the Contractor.

- D. Material Test Reports: Provide two copies of each test.
 - 1. Aggregate Material: Submit laboratory test reports that aggregates used in the bituminous mix conform to Section 703 of the MDOT Specifications.
 - 2. Asphalt Cement: Submit laboratory test reports that bituminous material used in the bituminous mix conforms to Section 702 of the MDOT Specifications.
 - 3. In-Place, Compacted Bituminous Concrete Mix: Submit laboratory test reports of samples cut from the in-place, compacted pavement indicating the percentage of theoretical maximum density (TMD), based on laboratory specimens of the mix combined in the proportions of the job mix formula.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be registered with and approved by authorities having jurisdiction and the MDOT.
- B. Qualifications of Bituminous Concrete Producer: Use only materials which are furnished by a bulk bituminous concrete producer regularly engaged in production of hot-mix, hot-laid bituminous concrete.
- C. Paving Contractor: Paving contractor shall be listed in the MDOT prequalified contractor list for paving projects and shall be valid at time of paving operations.
- D. Testing Agency Qualifications: Use only recognized commercial testing laboratories with not less than 5 years experience in conducting tests and evaluations of bituminous concrete materials and design.
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review condition of subgrade and preparatory work.
 - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Tack Coat and Prime Coat: Minimum ambient temperature in the shade is 40 degree F and rising, immediately prior to application;
 - 2. Asphalt Base Course: Minimum surface temperature of 40 degree F and rising at time of placement;
 - 3. Asphalt Binder (Intermediate) Course: Minimum surface temperature of 40 degree F and rising at the time of placement; and,
 - 4. Asphalt Surface Course: Minimum surface temperature is above 50 degree F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Aggregates: Conform to Section 703 of MDOT Specifications.

2.2 ASPHALT MATERIALS

- A. Asphalt Cement: Conform to Section 702 of MDOT Specifications.
- B. Prime Coat - emulsified asphalt applications shall meet the requirements of AASHTO M 140, and the MDOT specifications.
- C. Tack Coat - emulsified asphalt applications shall meet the requirements of AASHTO M 140 and meet MDOT specifications.
- D. Water: Potable.
- E. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.3 MIXES

- A. Hot Mix Asphalt – Per MDOT approved mix.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.
- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 - 1. Mill to a depth as indicated on the drawings.
 - 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
 - 3. Control rate of milling to prevent tearing of existing asphalt course.
 - 4. The Contractor shall coordinate the adjustment of manholes, meter boxes, drainage inlets, and valve boxes with the milling operation.
 - 5. Repair or replace curbs, manholes, and other construction damaged during cold milling.
 - 6. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 - 7. Transport milled hot-mix asphalt to asphalt recycling facility.
 - 8. Keep milled pavement surface free of loose material and dust.
- B. All milled material shall become the property of the Contractor and shall be disposed of off-site or used in conformance with Section 312000, Earthwork, or for utilization as

Reclaimed Asphalt Pavement, in conformance with the specification provided above, as approved by the Owner.

3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
 - 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
 - 3. For patching where base or intermediate pavement is present, provide horizontal tack coat.
- D. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

3.5 SURFACE PREPARATION

- A. Proofroll crushed aggregate base in conformance with Section 312000 Earthwork, immediately prior to paving.

- B. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
 - 3. Adequate traffic control shall be provided to prohibit traffic from traversing applied area.
 - 4. Any foreign matter on tack coat is to be removed and area re-tacked before applying pavement.

3.6 HOT-MIX ASPHALT PLACING

- A. Plant Mix Hot Bituminous Pavement: Produce and place in conformance with Section 401 of MDOT Specifications.
- B. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Spread mix at minimum temperature of 250 deg F and maximum temperature of 325 deg F.
 - 3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- C. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

- D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 PERMANENT TRENCH PAVEMENT REPAIR

- A. Saw edges of existing pavement to provide a vertical bonding face.
- B. Remove temporary paving and sawn out existing paving.
- C. Reset manhole frames and covers.
- D. Apply a tack coat to the sawn edges.
- E. Apply hot mix asphalt as directed by Contract Documents.
- F. Roller compact both courses, compacting the final wear course to meet existing pavement surfaces exactly

3.8 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 5. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 95 percent of reference maximum theoretical density according to ASTM D 2041 for binder (intermediate) and surface courses.
 - 2. Average Density: $95\% \pm 2.5\%$ of reference maximum theoretical density according to ASTM D2041 for base courses.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/4 inch.
 - 2. Binder (Intermediate) Course: Plus or minus 1/4 inch.
 - 3. Surface Course: Plus or minus 1/4 inch.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Binder (Intermediate) Course: 1/4 inch.
 - 3. Surface Course: 1/4 inch.
 - 4. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
- C. Contractor's duties relating to testing include:
 - 1. Notify Owner 72 hours prior to asphalt paving;
 - 2. Notifying laboratory of conditions requiring testing; and

3. Coordinate with laboratory for field testing.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Testing agency shall be paid by the Owner.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples, at random locations, of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements at no cost to the Owner.

3.12 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321613.43 - GRANITE CURBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Granite curbing.
- 2. Granite curbing for tree wells.

- B. Related Sections include the following:

- 1. Division 31 Section "Earth Moving" for excavation and compacted subgrade.

1.3 DESCRIPTION OF WORK

- A. Provide all materials, equipment, and labor necessary for the placement of granite curbing as shown within the Contract Documents and as specified herein.

1.4 PROJECT CONDITIONS

- A. Work on Public Ways: Comply with all regulations and requirements of local/state agencies having jurisdiction.

- B. Weather Limitations: Comply with requirements in MDOT.

PART 2 - PRODUCTS

2.1 GRANITE CURBING

- A. Provide curbing complying with MDOT Specifications Section 712.04, Vertical Curb, Type 1 and Sloped Granite Curbing, Type 5, complying with MDOT Material Specifications 712.04.
- B. Circular granite curb shall be in reasonable close conformity with the shape and dimensions as shown in the Contract Documents and to the applicable material requirement.

- C. Joint mortar shall be in accordance with MDOT Section 705.02.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated on Drawings and except as otherwise specified or indicated in compliance with MDOT 609.03.
- B. Set curb with vertical face plumb, curb top parallel to adjacent surface.
- C. The required spacing between sections of curb shall be assured by the use of an approved spacing device to provide an open joint between stones of at least 1/4 inch and no greater than 5/8 inch.
- D. Set curb accurately to line and grade. Fit units as closely together as possible. Do not field cut curbing.
- E. Backfilling: All remaining spaces under the curb shall be filled with approved material and thoroughly hard tamped so the curbing will have a firm uniform bearing on the foundation for the entire length and width. Any remaining excavated areas surrounding the curb shall be filled to the required grade with approved materials. This material shall be placed in layers not exceeding 8 inches in depth, loose measure and thoroughly tamped.
 - 1. When backfill material infiltrates through the joints between the stones, small amounts of joint mortar or other approved material shall be placed in the back portion of the joint to prevent such infiltrating.
 - 2. Reset any curb section disturbed during backfilling or otherwise reset to proper line and grade and properly backfill.

3.2 PROTECTION

- A. Protect the curb and keep in good condition. Clean all exposed surfaces smeared or discolored and restored to a satisfactory condition or the curb stone removed and replaced.

END OF SECTION 321613.43

SECTION 321723 - PAVMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Pavement-marking paint.

- B. Related Sections:

- 1. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: Provide data on paint products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with MDOT Specifications, Section 708.03 (Type F).
 - 1. Color: White.

2.2 EQUIPMENT

- A. Equipment used for the application of pavement striping shall be fully powered and of standard commercial manufacture. Truck mounted equipment may be approved is, in the opinion of the Owner's Representative, the quality of the work of the machine is satisfactory.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The use of white and yellow materials will require thorough cleaning of equipment so as not to mix the colors. Any mixture of colors will be deemed sufficient reason for rejection of the work be the Owner's Representative, and replacement by the Contractor.

3.2 LAYOUT

- A. The transverse lines, established by the Contractor for control of striping, shall be chalked as a guide and shall be approved by the Owner's Representative before the application of any striping. The length of line shall be measured and marked by the Contractor for the locations listed below. All pavement markings shall be in accordance with the applicable sections of the Manual of Uniform Traffic Control Devices for Streets and Highways, 2001 edition, or most recent.
- B. Stripe pavement graphics shown/detailed on Drawings. Fire lanes, crosswalks, etc. to be marked as shown on Drawings.

3.3 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner's Representative.
- B. Allow paving to age for 48 hours before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.

- D. Apply paint in accordance with MDOT Standard Specifications, Section 627.
- E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.4 PROTECTION

- A. Place temporary barriers to keep traffic off paint throughout required drying time.

3.5 CLEANING

- A. If for any reason, paint is spilled or tracked on the pavement, or any markings applied by the Contractor, in the Owner's Representative's judgment, fail to conform to the requirements of this Section, because of a deviation from the desired pattern, the Contractor shall remove such paint by a method that is not injurious to the pavement surface and is acceptable to the Owner's Representative, clean the pavement surface and prepare the surface for a reapplication of markings; and reapply the markings as directed without additional compensation for any of the foregoing corrective operations.

END OF SECTION 321723

SECTION 321726 - TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Surface-applied detectable warning tiles.

- B. Related Requirements:

- 1. Section 321400 "Unit Paving" for unit paving installations incorporating detectable warning unit pavers specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Samples for Initial Selection: For each type of exposed finish requiring color selection.

- C. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

- B. Weather Limitations for Adhesive Application:

1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
 - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering and wear.
 - b. Separation or delamination of materials and components.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for tactile warning surfaces.
 1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. Source Limitations: Obtain each type of tactile warning surfacing from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles with replaceable surface configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
1. Product: As indicated on the drawings.
 2. Material: Molded glass- and carbon-fiber-reinforced polyester.
 3. Color: Gray.
 4. Shapes and Sizes:
 - a. Rectangular panel, 24 by 48 inches.
 5. Dome Spacing and Configuration: Manufacturer's standard compliant spacing, in square pattern.
 6. Mounting:
 - a. Replaceable detectable warning tile wet-set into freshly poured concrete and surface-fastened to permanently embedded anchors.
- B. Setting Bed: Comply with requirements in Section 321400 "Unit Paving."
- C. Mortar Setting Bed at Perimeter:
1. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
 2. Sand: ASTM C 33/C 33M.
 3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
 4. Thinset Mortar: Latex-modified portland cement mortar complying with ANSI A118.4.
 5. Water: Potable.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
1. Furnish Type 316 stainless-steel fasteners for exterior use.
 2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

- A. Removable Cast-in-Place Detectable Warning Tiles:
 - 1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.
 - 2. Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
 - 3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
 - 4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
 - 5. Clean tiles using methods recommended in writing by manufacturer.

3.4 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

CPORT CREDIT UNION
50 INDIA STREET
PORTLAND, MAINE
GTA #010416

END OF SECTION 321726

SECTION 321729 - TRAFFIC SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Parking signs.

PART 2 - PRODUCTS

2.1 SIGNS

- A. Provide signs conforming to the requirements of MDOT standards and section 645 of the MUTCD standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in conformance to the requirements of MDOT standards.

END OF SECTION 321729

SECTION 330516 – UTILITY STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes storm drainage structures outside the building, with the following components:
 - 1. Concrete light bases.
 - 2. Electric/Tel-data manholes.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 SUBMITTALS

- A. Product Data: Manufacturers' product data and installation instructions for utility structures.
- B. Shop Drawings: For the following:
 - 1. Precast Concrete Items: Include plans, elevations, sections, details, and frames, covers, and grates.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Handle concrete structures according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 LIGHT POLE BASES

- A. As per Bayside Light requirements.

2.2 ELECTRIC/TEL-DATA MANHOLES

- A. Refer to the information on the drawings.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 LIGHT POLE BASE INSTALLATION

- A. Install as shown on drawings.

3.3 ELECTRIC/TEL-DATA MANHOLE INSTALLATION

- A. Install as shown on drawings.

END OF SECTION 330516

SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service, with the following components:
 - 1. Water mains.
 - 2. Water services.
 - 3. Water fittings.
- B. This Section includes water-distribution piping and related components outside the building for fire-service mains, with the following components:
 - 1. Water mains.
 - 2. Water services.
 - 3. Water fittings.
- C. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified local requirements.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:

1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store pipe, fittings, and seals in accordance with manufacturer's recommendations.
- B. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- C. Protect flanges, fittings, and specialties from moisture and dirt.
- D. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:
 1. Notify Owner's Representative or Local Utility no fewer than two days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without written authorization from Owner's Representative or Local Utility.

1.7 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Approved Manufacturers:
 1. American Cast Iron Pipe.
 2. Griffin Pipe.
 3. U.S. Pipe.
 4. Clow Pipe.

5. McWain Pipe.
6. Atlantic States Pipe

B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, Class 52, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated. The pipe to be centrifugally cast, bituminous coated, double cement lined, seal-coated and manufactured in accordance with the latest revision of AWWA C150 and C151. Note that the cement lining called for above shall be twice the thickness specified in the latest ANSI Specification A21.4 and the interior to be asphalt seal-coated twice. The asphalt seal-coat to be such as not to impart taste or odor to the water contained therein.

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.

C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, Class 52, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated. The pipe to be centrifugally cast, bituminous coated, double cement lined, seal-coated and manufactured in accordance with the latest revision of AWWA C150 and C151. Note that the cement lining called for above shall be twice the thickness specified in the latest ANSI Specification A21.4 and the interior to be asphalt seal-coated twice. The asphalt seal-coat to be such as not to impart taste or odor to the water contained therein.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.2 DUCTILE IRON FITTINGS

- A. Material shall be ASTM A536 latest, grade 70-50-05, in accordance with AWWA C110 (latest revision) for fittings larger than 24" and C153 (latest revision) for fittings 3" thru 24".
- B. Fittings shall be cement lined AWWA C104 (latest revision) or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116.
- C. Interior seal coated AWWA C104 with minimum of 4 mils dry film thickness.
- D. Exterior bituminous coated, 4 mils minimum dry film thickness or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116.
- E. Sleeves shall not be cement lined, but shall be bituminous coated inside to 4 mils dry film thickness. All sleeves shall be long body type.
- F. Mechanical joint with accessories furnished: D.I. glands, gaskets, Cor-Ten T- bolts and nuts.

G. Pressure Ratings:

1. Class 350 pressure rating in accordance with AWWA C153 - 3" - 24" sizes.

H. The "compact design" fittings must provide adequate space for the MJ joint and accessories to be installed without special tools (i.e. Lowell wrench can be used).

I. Approved Manufacturers

1. In conformance with Yarmouth Water District specifications.

2.3 RESTRAINED JOINT GASKETS

A. Approved Manufacturers:

1. American Fast-Grip Gasket – American Pipe.
2. Field Lok 350 Gasket – US Pipe.

B. All accepted restrained joint gaskets in the distribution system shall be rated in accordance with the performance requirements of ANSI/AWWA C111/A21.11.

C. Required Applications

1. Any hydrant branch or service with a distance greater than 18' shall have an approved restrained joint gasket in the bell ends.
2. Where a casing is required, all joints within the casing shall have an approved restrained joint gasket unless restrained joint pipe is used.
3. At any time as required by a PWD Engineer.
4. Any live service tap where there is a joint between the connection and the end of the service.

2.4 GATE VALVES

A. Approved Gate Valves

1. U.S.P.
2. AFC Series 2500
3. Mueller A-2360/61
4. Clow Series F6100

B. Valve shall meet the latest revision of the AWWA C-509 or C- 515 Standard.

C. Valve shall have a smooth unobstructed water way which shall be a minimum diameter of the valve.

D. Valve ends to be specified and shall be furnished with Cor-ten (or equal) bolts and nuts.

E. Valve shall be rated for zero leak rate at 200 psi differential working pressure and have

1. 400 psi hydrostatic test for structural integrity.
- F. Sealing - Valve shall have a minimum of 2 “O” rings situated such that the “O” rings above the thrust collar can be replaced with the valve under pressure and in the open position.
- G. Stem - Valve stem shall:
1. open right with a stem nut made of grade D,E manganese bronze;
 2. be non-rising;
 3. be designed with a thrust collar integrally cast to the stem;
 4. be designed with two (2) thrust washers, placed one above and one below the stem thrust collar;
 5. be constructed of grade D,E manganese bronze;
 6. be such that the thrust washers are made of a synthetic polymer with physical properties required.
- H. Valve Body: The body, including the stuffing box and the bonnet, shall be constructed of cast iron or ductile iron, meeting the latest revision of AWWA C-153.
- I. Valve Wedge:
1. shall be constructed of ductile iron (less guiding mechanism);
 2. shall be fully encapsulated and permanently bonded with a resilient elastomer;
 3. shall be constructed such to allow the flushing of any interior exposed surface during operations.
- J. Coatings:
1. the internal and external valve body, including the stuffing box, bonnet, and interior of the wedge shall be fusion bonded epoxy coated with 8 mils D.F.T.
 2. interior shall meet latest version of AWWA C-550.
 3. shall be holiday free, interior and exterior, per testing method described in AWWA C-550, Sec. 5.1.
- K. Operating Nut:
1. shall be two (2) inch square ductile iron:
 2. with a countersunk hold down nut (made of 316 stainless steel or silicone bronze). This applies to stems that are tapered; or
 3. with a stainless steel pin inserted thru the stem. This applies to stems of full diameter.
- L. Bolts – The seal plate and bonnet bolts shall be stainless steel (Type 316 or Type 304).
- M. Valves 12” nominal diameter and smaller shall be directly operated by the nut on the valve stem and mounted vertically. Number of turns to open or close shall closely match the formula: $(3 \times D) + 2$. For example, a 12” valve should open or close with approximately $(3 \times 12) + 2 = 38$ turns of the operating nut.

- N. Valves larger than 12" nominal diameter shall be designed to be installed horizontally and shall have bevel gear operators driven by the operating nut. Valves 14" – 24" nominal diameter shall have 4:1 bevel gear operators. Valves with 30" – 36" nominal diameters shall have 6:1 bevel gear operators and valves with 42" – 48" nominal diameters shall have 8:1 bevel gear operators. Number of turns to open or close shall closely match the formula: $((3 \times D) + 2)$ times the bevel gear ratio. For example, a 24" valve should open or close with approximately $((3 \times 24) + 2) \times 4 = 296$ turns of the operating nut.
- O. General Provisions
1. Vendor shall identify any and all exceptions to the specifications.
 2. Vendor shall provide standard brochures for item quoted.
 3. Vendor may be required to supply a valve for inspection and determination of coating process.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Approved Manufacturers:
 - a. AFC.
 - b. Mueller Co.
 - c. U.S. Pipe.
 - d. Tyler / Union.
 - e. Powerseal Model 3490 and 3490MJ (Fabricated Steel)
2. For sizes 12" and smaller tapping sleeve shall be ductile iron or approved fabricated steel:
 - a. Tapping sleeve shall be mechanical joint with recessed outlet flange for tapping valve.
 - b. Tapping sleeve shall conform to AWWA C-207, Class D, with rated maximum working pressure of 200 psi.
 - c. The side rubber gaskets shall be rectangular in cross-section and fit into grooved channels in the casting. These gaskets shall extend the entire length of the sleeve and shall not require cutting or trimming to match MJ end gaskets.
 - d. Tapping sleeve shall be AB-CD pattern to permit use of plain rubber and ducktipped gaskets for various O.D. piping sizes.
 - e. Mechanical joint with accessories furnished; glands, gaskets, and Cor-Ten T-bolts and nuts or equal.
 - f. All flange outlet bolts shall be stainless steel (Type 304).
 - g. Interior and exterior to be bituminous coated with a minimum of 4 mils dry film thickness or fusion bonded epoxy coated.
 - h. The sleeve shall be provided with a 3/4" F.I.P.T. test port and brass lug.

B. Valve Boxes:

1. The valve box bottom section shall be slide-type with bell-type base with bottom lip. Manufacturer: North American Manufacture
2. The valve box top section shall be slide-type, 36 inches long (minimum). No top flange and no "bead" or bottom flange. Manufacturer: North American Manufacture
3. The valve box cover shall be a 2" drop-type cover to fit the 7- 1/4" opening of the top section. Manufacturer: Bibby St-Croix (no substitute)
4. The valve box intermediate (mid) section shall be slide-type with a minimum 3" belled bottom. Base section No. 645 may be used as an alternate. Manufacturer: North American Manufacture
5. Material shall be cast iron or ductile iron free from defects.
6. Interior and exterior of all components shall be bituminous coated with a minimum of 4 mils dry film thickness.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 INSTALLATION

A. General:

1. Install all pipe and fittings in strict accordance with the manufacturer's instructions and recommendations, and in conformance with Local Water District's standards.
2. Install all pipes and fittings in accordance with the lines and grades shown on the Drawings and as required for a complete installation. Minimum depth of cover for water main shall be 5' - 6".
3. Install adapters, as required, when connecting pipes constructed from different materials.

B. Pipe Laying:

1. Firmly support the pipe and fittings on bedding material as shown on the Drawings and as specified in the appropriate Sections of these Specifications.
2. Do not permanently support the pipe or fittings on saddles, blocking stones, or any material which does not provide firm and uniform bearing along the outside length of the pipe.
3. Thoroughly compact the material under the pipe to obtain a substantial unyielding bed shaped to fully support the pipe.
4. Excavate suitable holes for the joints so that only the barrel of the pipe received bearing pressure from the supporting material after placement.
5. Lay each pipe length so it forms a close joint with the adjoining length and bring the inverts to the required grade.
6. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.

7. When each pipe length has been properly set, place and compact enough of the bedding material between the pipe and the sides of the trench to hold the pipe in correct alignment.
8. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
9. Take all necessary precautions to prevent flotation of the pipe in the trench.

C. Temporary Plugs:

1. When pipe installation work in trenches is not in progress, close the open ends of the pipe with temporary watertight plugs.
2. If water is in the trench when work is resumed, do not remove plugs until all danger of water entering the pipe is eliminated.
3. Do not use the pipelines as conductors for trench drainage during construction.

D. Jointing Push-On Pipe:

1. Connect pipe in accordance with the latest manufacturer's instructions and recommendations.
2. Clear each pipe length, coupling and fitting of all debris and dirt before installation.
3. Shove home each length of pipe against the pipe previously laid and hold securely in position. Do not pull or cramp joints.
4. Make all pipe joints as watertight as possible with no visible leakage and no sand, silt, clay, or soil of any description entering the pipeline at the joints.
5. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.

E. Jointing Bolted Joints:

1. Before the pieces are assembled, remove rust-preventative coatings from machined surfaces.
2. Pipe Ends, Sockets, Sleeves, Housings, and Gaskets: Thoroughly clean and smooth burrs and other defects.

F. Jointing Mechanical Joints:

1. Thoroughly brush surfaces against which the gasket will come in contact with a wire brush prior to assembly of the joint.
2. Clean and lubricate the gasket, bell, and spigot by washing with soapy water.
3. Slip gland and gasket, in that order, over the spigot, and insert the spigot into the bell until it is correctly seated.
4. Seat gasket evenly in the bell at all points, centering the spigot, and press the gland firmly against the gasket.
5. After all bolts have been inserted and the nuts have been made up finger tight, progressively and uniformly tighten diametrically opposite nuts all around the joint to the proper tension by means of a torque wrench.
6. The correct range of torque as indicated by a torque wrench and the length of wrench (if not a torque wrench) used by an average man to produce such range of torque, is as follows:

TORQUE RANGE VALUES

Range of torque 60-90 ft - lb.

Length of wrench 10 in.

7. If effective sealing of the joint is not attained at the maximum torque indicated above, disassemble the joint, thoroughly clean, and reassemble.
8. Do not overstress bolts to tighten a leaking joint.

G. Pipe Cutting:

1. Cut in accordance with manufacturer's recommendations.
2. Cut the pipe with a hand saw, metal-inserted abrasive wheel (except asbestocement pipe), or pipe cutter with blades (not rollers).
3. Examine all cut ends for possible cracks caused by cutting.

H. Pipe Insulation:

1. Install 2 in. thick x 4 ft. wide between pipe and culvert or over pipe when noted on plans.
2. Between culvert and pipe, extend insulation 6 ft. each side of the culvert along the pipe.
3. For dual pipe trenches the insulation shall be 8 ft. wide.
4. Provide 6 in. sand blanket above and below insulation or as shown on Drawings.

I. Pipe Deflection Allowances: Per manufacturer's recommendations or Local Water District recommendations, whichever is more stringent.

J. Valve Installation:

1. Install in accordance with the specifications for the pipe to which they are to be connected.
2. Make up valve joints in accordance with the Contract Drawings.
3. The valves shall bear no stresses due to loads from the adjacent pipe.
4. Inspect, clean, and lubricate before installation.

K. Bracing and Blocking:

1. Block and anchor all bends, 22½° or greater, tees, plugs, etc. with concrete to prevent movement of the pipe in the joints due to internal or external pressures.
2. Use thrust blocks behind all hydrants.
3. Use 2'x2'x4' concrete blocks manufactured from Pepin Concrete or approved equal. If blocks are poured, wrap joints and bolts with poly before pouring concrete.
4. Place concrete around fittings to the walls of the trench, as shown on the Drawings, so placed that joints may be caulked or tightened, if necessary.
5. Do not backfill until the concrete has set.
6. If the soil does not provide firm support for thrust block placement, provide retainer clamps and tie rods as shown on the Drawings and/or directed by the Owner's Representative.

7. Thrust restraint glands for mechanical joint fittings manufactured by Megalug or Grip Ring.
- L. Air Vents and Blowoffs, Corporation Stops, Curb Stops, Valve Boxes, Copper Tubing and Styrofoam Insulation: Install in accordance with Local Water District requirements, the Drawings and as directed by the Engineer.
- M. Vertical Separation From Sanitary Sewer:
 1. Whenever water mains must cross sewers, lay at such an elevation that the top of the sewer is at least 18 in. below the bottom of the water main.
 2. When the elevation of the sewer cannot be buried to meet the above requirements, center one full length of water main over the sewer so that both joints will be as far from the sewer as possible.
- N. Water Service Leads and Stops:
 1. Provide and install corporation valves, water service leads, and curb stops for proposed building connections as shown on the Drawings, or where directed by the Architect.

3.3 PRESSURE TESTING AND DISINFECTION

- A. Pressure testing and disinfection shall be in accordance with AWWA C600 and AWWA C651 standards.
- B. Pressure testing and disinfection shall be performed in strict accordance with Local Water District requirements.
- C. Pressure testing and disinfection shall be performed in the presence of the representative of the Yarmouth Water District and the Engineer.

END OF SECTION 331100

SECTION 333100 - SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes gravity-flow, non-pressure sanitary sewerage outside the building.

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For pipe and fittings.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified local requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.6 PROJECT CONDITIONS

- A. Portions of the existing sanitary sewer traversing the site shall remain active during construction and upon completion of project. Refer to Grading and Utility plan for proposed modification. Construction activities shall not interfere or impede existing flows. Damage to existing sewer infrastructure shall be repaired by Contractor at their expense.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- B. Provide commercially manufactured wyes or tees for service connections. Fitting must have single piece gasket.

2.2 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.3 RIGID INSULATION

- A. Extruded closed – cell rigid foamed polystyrene, 2 inch thickness, width of trench, Styrofoam HI-60 by Dow Chemical, or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves,

and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

- C. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
 - 2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use cast-in-place concrete supports or anchors.
 - 3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- D. No pipe installed will be allowed to begin at any point other than a manhole or other appurtenance without the expressed consent of the Owner's Representative. The interior of each length of pipe will be swabbed and wiped clean before installing the next length. No length of pipe shall be installed until the previous length has had sufficient fine material placed and tamped about it to secure it firmly in place to prevent any disturbance. Bell ends shall be installed uphill. Whenever the work is stopped temporarily, or for any reason whatsoever, the end of the pipe shall be carefully protected against dirt, water, or other extraneous material. Bedding shall be as shown on the drawings.
- E. The pipe shall be bedded in a compact granular or stone pipe bedding placed on a flat trench bottom to the limits indicated on the drawings.
- F. The pipe shall be cut as necessary for appurtenances. Sufficient short lengths of pipe shall be furnished so that pipe entering and leaving appurtenances shall not be more than 2 feet in length measured from the inside face of the manhole.
- G. Pipe Cutting: The cutting of the pipe shall be done in accordance with the pipe manufacturer's recommendations. The pipe material shall be cut by using a saw or milling process, approved by the pipe manufacturer and not by using any impact device, such as a hammer and chisel, to break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
 - 2. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 PIPE INSULATION

- A. Install 2-in. thick x 4-ft. wide insulation over pipe when noted on plans or as directed by the Owner's Representative.

3.5 CLOSING ABANDONED SANITARY SEWERAGE PIPING

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Backfill to grade according to Division 31 Section "Earth Moving."

3.6 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape over nonferrous piping.

3.7 FIELD QUALITY CONTROL AND TESTING

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspection to be performed with Owner's Representative present. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
- C. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
1. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
 2. Close openings in system and fill with water.
 3. Purge air and refill with water.
 4. Disconnect water supply.
 5. Test and inspect joints for leaks.
 6. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
- D. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
1. Equipment Requirements:
 - a. Pneumatic Plugs: Sealing length equal to or greater than the diameter of the pipe to be tested.
 - b. Pneumatic Plugs: Size and type to resist internal test pressures without requiring external bracing or blocking.
 - c. All air used shall pass through a single control panel.
 - d. Use three individual hoses for the following connections:
 - 1) From control panel to pneumatic plugs for inflation.
 - 2) From control panel to sealed line for introducing the low pressure air.
 - 3) From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
 2. Procedures:
 - a. Pneumatic Plug Seal Testing:
 - 1) Before being used in the actual test installation, lay one length of pipe on the ground and seal at both ends with the pneumatic plugs to be checked.
 - 2) Introduce air into the plugs to 25 psig.
 - 3) Sealed pipe shall be pressurized to 5 psig.
 - 4) The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
 - b. Pipe:
 - 1) Place plugs in the line and inflate to 25 psig.

- 2) Introduce low pressure air into sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of groundwater over the pipe.
- 3) Wait at least two minutes for the air pressure to stabilize.
- 4) After the stabilization (3.5 psig minimum pressure in the pipe), disconnect the air hose from the control panel to the air supply. The portion of line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) is greater than 4 minutes.

c. Where Groundwater is Known to Exist:

- 1) Install a one-half inch diameter capped pipe nipple, approximately 10' long, through the manhole wall on top of one of the pipes entering the manhole, at the time the pipe is installed.
- 2) Immediately prior to the performance of the Line Acceptance Test, determine the groundwater by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connect a clear plastic tube to the nipple.
- 3) The hose shall be held vertically and a measurement of the height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psig, add the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same).

d. Should the pipe, as laid, fail to meet these requirements, perform the necessary work to meet these requirements, without additional cost to the Owner.

E. Leaks and loss in test pressure constitute defects that must be repaired.

F. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.8 INFILTRATION AND EXFILTRATION TESTS

A. If the installation fails to meet the above requirements for the air test, the Contractor may either run an Exfiltration or infiltration test, as directed and if approved by the Engineer.

B. Leakage shall not exceed 100 gallons per inch diameter/day/mile of pipe, when tested by either internal pressure or external pressure means. Should the pipe, as laid, fail to meet these requirements, the Contractor shall perform the necessary work at his expense to meet these requirements. Where groundwater is high, the Engineer may elect to accept infiltration measurements in lieu of exfiltration tests.

C. Infiltration Tests:

1. Requires groundwater levels to be a minimum of one foot above the crown of the pipe of the high end of the section being tested.
2. Infiltration Test Procedures:
 - a. Engineer to determine length of sewer main and connecting lines to be tested.
 - b. No more than 1,000 feet of sewer main is to be laid before testing.
 - c. With all connecting pipes plugged (other than those included in test section) install a V notch weir in downstream end of pipe.
 - d. Allow time for water to buildup behind weir until steady, uniform flow passes through V notch.
 - e. Take and record readings under direction of the Engineer.

D. Exfiltration Test:

1. Procedures:
 - a. Engineer to determine length of sewer to be tested.
 - b. Properly cap or plug and block service laterals, stubs and fitting into sewer lines being tested.
 - c. Plug downstream ends of test section providing a water supply connection standpipe in manhole upstream.
 - d. Fill test section and upstream standpipe and allow time for water absorption in manholes.
 - e. Measure drop in upstream standpipe over 4 - 15 minute periods and compute leakage.

3.9 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 333100

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Storm drain piping.

1.3 DEFINITIONS

- A. PE: Polyethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Storm drain piping.
- B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- C. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- D. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 PE PIPE AND FITTINGS

- A. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
 - 1. Product: N-12 ST by Advanced Drainage Systems, Inc. (ADS)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Gravity-Flow, Nonpressure Sewer Piping: Use the following pipe materials for each size range:
 - 1. NPS 8 to NPS 12: Corrugated PE drainage pipe and fittings in NPS 8 and NPS 10 and corrugated PE pipe and fittings in NPS 12, silttight couplings, and coupled joints.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install piping below frost line.
 - 3. Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

3.4 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join corrugated PE piping according to CPPA 100 and the following:
 - a. Use silttight couplings for Type 2, silttight joints.
- C. Join dissimilar pipe materials with pressure-type couplings.

3.5 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

3.6 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.

- c. Option: Test concrete piping according to ASTM C 924.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.8 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100