MAINE TURNPIKE AUTHORITY

ADDENDUM NO. 3

CONTRACT 2026.07

CROSBY MAINTENANCE OFFICE BUILDING

The bid opening date is December 9, 2025 at 11:00 A.M.

A pre-bid conference was held on November 4, 2025 at 10:00 A.M. at Maine Turnpike Authority.

The following changes are made to the Proposal, Specifications and Plans. Refer to the Questions section for additional information.

GENERAL

All questions regarding Contract 2026.07 should be submitted by Noon on December 2, 2025 to be answered by Addendum on or before December 4, 2025. Questions received after that time may not be answered.

PROPOSAL

• Intentionally left blank.

SPECIFICATIONS

The following specification sections have been issued with this Addendum:

- 033500 – Polished Concrete
- 064000 – Architectural Woodwork
- 108500 – Building Specialties

The following specification sections have been revised and reissued with this Addendum:

- Table of Contents
- Schedule of Bid Prices
- 074113 – Metal Roof Panels
- 075323 – Ethylene-Propylene-Diene-Monomer (EPDM) Roofing
- 076200 – Sheet Metal Flashing and Trim SHEET
- 084113 – Aluminum-Framed Entrances and Storefronts
- 221616 – Facility Liquified-Petroleum Gas Piping
- 230900 – Instrumentation and Control for Mechanical Systems

PLANS

The following drawings have been revised and reissued with this Addendum:

1. DRAWING A11-1 – ENLARGED PLANS
2. DRAWING A15-1 – ROOF PLAN
3. DRAWING A55-2 – STOREFRONT DETAILS

4. DRAWING A61-1 – ROOM FINISH SCHEDULE
5. DRAWING A80-2 – STANDARD INTERIOR DETAILS
6. DRAWING A81-1 – INTERIOR ELEVATIONS AND DETAILS
7. DRAWING M60-2 – SCHEDULES
8. DRAWING E80-1 – SITE PLAN

QUESTIONS

The following are questions submitted to the Maine Turnpike Authority in writing. Answers to the questions are noted. Bidders shall utilize this information in preparing their bid.

Question 23: Spec 074113 Metal Roof Panels 2.4) Concealed- Fastener Lap-Seam Metal Roof Panels B) Standing Seam Profile 3) Panel Coverage A) Canopies (12 inches), B Main Roofs (18 inches) 4) Panel Height: 1.5 inches: Provide 2 inches high at low slope roof areas. The (2) canopies are EPDM roofs. I am only seeing steep slope roof areas (6:12 and 10:12) which would require 1.5" tall seams and 18" wide roof panels. Please clarify the metal roof panel scope (seam height and roof panel width required on the (2) steep sloped roof areas) on this project.

Answer: **See revised specification issued with this Addendum.**

Question 24: Drawing sheet A15.1 Roof Plan R1 is the new standing seam metal roofing assembly but R2 calls out "Standing Seam Metal Roofing on comp insul should actually read "R2 EPDM Roof system on (2) low slope roofs". Please clarify.

Answer: **See revised drawing issued with this Addendum.**

Question 25: Within which pay item should the Risers on the new utility poles be placed? There will be one each for the 12kv wire and the comm.

Answer: **This shall be included under site conduit and wiring.**

Question 26: Within which pay item should the "upgraded" wiring for the 8 bay garage be placed??

Answer: **This shall be included under site conduit and wiring.**

Question 27: For S02, should we put the items related to connection of this in the pay item for the building??

Answer: **This keyed note will be revised to reference division 670 on the P sheets. Please include all related items under 670.11.**

Question 28: The material finish for the floor states sealed concrete, and also polished concrete. What is the expected finish and is there a product or specification?

Answer: **See Specification 033500 – POLISHED CONCRETE issued with this Addendum.**

Question 29: Is there a specification for the corner guards?

Answer: **See specification 108500 – Building Specialties issued with this Addendum.**

Question 30: Who is responsible for the builder's risk policy?

Answer: **Reference The Supplemental Specifications Section 110.3.6.**

Question 31: Confirm the inspectors for special inspections are being engaged and paid for by the Owner

Answer: **Confirmed.**

Question 32: This is in spec 221616 2.5 B - we assume an error - confirm no alternates on the project.

18. ALTERNATE #5: Provide regulator set to deliver the required operating pressure for the emergency generator.

Answer: **See revised specification section issued with this Addendum.**

Question 33: Regarding bid units 203.2333 - *Disposal and Treatment of Special Excavation*, and 203.234 *Treatment or Disposal of Contaminated Groundwater*; Is any characterization data available for existing site soil contamination? Should offsite disposal be required for soil and/or groundwater, the required disposal locations and tipping fees could vary substantially. This leaves the bidder's only safe option to price as a worst case (hazardous waste).

Answer: **There is no data available and it is expected that there is no contamination in the development area.**

Question 34: What is the anticipated start date for this project?

Answer: **The MTA will entertain a start date for this work after a successful MTA Board Approval and the MTA is scheduled to consider the contract award on December 18, 2025.**

Question 35: Is builders risk required?

Answer: **Reference The Supplemental Specifications Section 110.3.6.**

Question 36: There are no specs on what they want for Plam and or solid surface and in the window sills. It say" Post form sill" so what material are they proposing. Please clarify

Answer: **See Drawing A55-2 "STOREFRONT DETAILS" reissued with this Addendum.**

Question 37: The room finish schedule has nothing for materials. Please clarify.

Answer: **See Drawing A61-1 "ROOM FINISH SCHEDULE" reissued with this Addendum.**

Question 38: The specs call for storefront and the drawings are showing curtain wall. Please confirm which product it is

Answer: **See specification 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.**

Question 39: Regarding bid units 203.2333 - *Disposal and Treatment of Special Excavation*, and 203.234 *Treatment or Disposal of Contaminated Groundwater*; Is any characterization data available for existing site soil contamination? Should offsite disposal be required for soil and/or groundwater, the required disposal locations and tipping fees could vary substantially. This leaves the bidder's only safe option to price as a worst case (hazardous waste).

Answer: **There is no data available and it is expected that there is no contamination in the development area.**

Question 40: Allowances state "Refer to Section 260010 Field Conditions – CMP electrical utility cash allowances. Allowances are to be included as part of the Electrical filed sub-bid base bid. Refer to Section 270010 Coordination – Consolidated communications utility cash allowances. Allowances are to be included as part of the Electrical filed sub-bid base bid." Are sub bids required for this project? There is no mention of either of these allowance amounts in 260010 and 270010. Please clarify.

Answer: **See section 260010 1.11.B and section 270010 1.3.C for allowances noted.**

Question 41: Does the EC need to provide a 200A breaker in the existing MDP located in the 8- bay garage?

a. If so, can you please provide panel type information and verify there is adequate space for a new 200A framed breaker.

Answer: **No, an existing 200A (spare) breaker is already installed in the 8-Bay garage MDP.**

Question 42: On the electrical site drawing E80-01 the following is stated:

a. States "upgrade existing feeders from utility pole as required to match 400A panel capacity"
   i. Not sure what is existing and if this is already sized at 400A?
      Answer: **These are the feeders serving the 400A MDP in the 8-Bay garage, as shown on the Riser diagram E50-1**
   ii. Is the conduit infrastructure able to withstand new conductor sizing if needed?
      Answer: **Unknown – provide pricing to completely replace the service feeder if the size is insufficient.**
   iii. Will the conduit need to be re-worked at the pole location?
      Answer: **If the conduit size is insufficient for the required feeders, then yes.**

b. "Provide (2) 4'x6' vaults for telecom, cable to be spliced"
   i. Who is responsible for purchasing the vaults?
      Answer: **The contractor is responsible for purchasing the vaults.**
   ii. Who is responsible for pulling/splicing the telecom?
      Answer: **The contractor is responsible for pulling and splicing the telecom wiring. Confirm any requirements for splicing with the utility.**

c. "Provide 3 -2/0, 1 #6G from utility pole to vault"
   i. The two vaults are noted to be for telecom, is this not true and it is one for telecom and one for power?
      Answer: **Note clearly states "VAULT (ONE EACH) FOR CONNECTION OF POWER AND TELECOM"**
   ii. EC responsible for pulling and splicing in vault or is this CMP task?
      Answer: **EC is responsible for pulling and splicing in vault. CMP's scope ends at the riser pole.**

d. "Coordinate the re-routing of additional existing customer owned

underground electrical and telecom lines servicing police garage to overhead poles"

i. What does this work consist of? This is a vague note, Underground conduit size? Quantity? Pull strings? Wire?

Answer: **Existing underground conduits for power and data to police garage and to be demolished during site excavation and re-routed on new poles. Note will be updated to clarify. Exact size of conduits is unknown, it is expected that there is one conduit for power and one for telecom.**

e. Provide (4) 3" conduits under existing driveway for future use by owner, provide manholes on either side"

i. What type of manholes?

Answer: **Provide Heavy Duty precast concrete manholes in accordance with specification section 260543 2.5.B. Note will be updated on the drawings.**

ii. Furnished by who?

Answer: **Contractor.**

iii. Traffic rated?

Answer: **Refer to requirements in specification.**

iv. Also shows a dotted line from the manhole to the building, is this conduit in place or needs to be added? Conduit size?

Answer: **This represents (2) 2" conduits with pull strings per note on drawing. These are to be provided by the contractor.**

f. "Provide new covers for circular EMH"

i. Furnished by who?

Answer: **Contractor to provide.**

g. "Provide (2) 2" with pull string routed to exterior of 5-bay garage for future use"

i. Distance and or conduit pathway for this request as it is not shown on drawings.

Answer: **Conduit pathway is shown dashed, it is only about 10' to the wall of the 5-bay garage.**

h. The new 200A feed from the existing garage to the new building goes into a new manhole

i. Manhole furnished by who?

Answer: **Contractor to provide.**

ii. Sizing?

Answer: **Size and locate as required for best route. Provide Heavy Duty Precast Manhole per specification 260533.**

iii. Also looks like the 1" conduit for the pump routes through the same manhole, is that true? Is a manhole for the pumps required? Will there be an exterior alarm for the pump system?

Answer: **Correct, a 1" conduit for the pump is also shown routed through the manhole. Based on structural footing locations, this was determined to be the easiest route, however a manhole is not required for this conduit (but is still required for the pump) if a more direct route is found in the field. The alarm for the pump system will be connected to the Building Automation System (BAS) as noted in keynote S02 on sheet E80-1, and an exterior alarm will not be required.**

Question 43: There are no exact locations shown as to where these conduits will stub up within existing buildings.

a. Are there locations for these stub ups?

Answer: **Underground routing is shown to stub up locations. See sheet E20-1 for location of Panel HDP in room A114. Stub ups should be directly below this panel and have been coordinated on the drawings.**

b. Who is coring for building entrances?

Answer: **To be coordinated by the contractor and building foundations.**

c. Any inside overhead pathways required?

Answer: **No overhead electrical feeder pathways are expected to be required within the building. All individual load wiring shall be overhead or in wall with the exception of loads within the mechanical and electrical rooms, as defined by the specifications.**

ATTACHMENTS

- This document - Addendum #3 (8 pages)
- Specification Section Table of Contents (4 pages)
- Specification Section Schedule of Bid Prices (11 pages)
- Specification Section 033500 – Polished Concrete (4 pages)
- Specification Section 064000 – Architectural Woodwork (11 pages)
- Specification Section 074113 – Metal Roof Panels (11 pages)
- Specification Section 075323 – Ethylene-Propylene-Diene-Monomer (EPDM) Roofing (16 pages)
- Specification Section 076200 – Sheet Metal Flashing and Trim (14 pages)
- Specification Section 084113 – Aluminum-Framed Entrances and Storefronts (16 pages)

- Specification Section 108500 – Building Specialties (3 pages)
- Specification Section 221616 – Facility Liquified-Petroleum Gas Piping (16 pages)
- Specification Section 230900 – Instrumentation and Control for Mechanical Systems (39 pages)
- DRAWING A11-1 – ENLARGED PLANS
- DRAWING A15-1 – ROOF PLAN
- DRAWING A55-2 – STOREFRONT DETAILS
- DRAWING A61-1 – ROOM FINISH SCHEDULE
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- DRAWING A81-1 – INTERIOR ELEVATIONS AND DETAILS
- DRAWING M60-2 – SCHEDULES
- DRAWING E80-1 – SITE PLAN

Notes: The above items shall be considered as part of the bid submittal.

The total number of pages included in this addendum is one hundred sixty-one (161) pages. All bidders are requested to acknowledge the receipt of the Addendum No. 3 by signing below and email this sheet to Nathaniel Carll, Purchasing Department, Maine Turnpike Authority at ncarll@maineturnpike.com Bidders are also required to acknowledge receipt of this Addendum No. 1 on Page P-10 of the bid package.

_____
Business Name

_____
Print Name and Title

_____
Signature

_____
Date

Very truly

yours,
MAINE TURNPIKE AUTHORITY

_____
Nathaniel Carll
Purchasing Department
Maine Turnpike
Authority

MAINE TURNPIKE AUTHORITY
CROSBY MAINTENANCE BUILDING
CONTRACT 2026.07

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MAINE TURNPIKE AUTHORITY

PROPOSAL

CONTRACT 2026.07

CROSBY MAINTENANCE OFFICE BUILDING

TO MAINE TURNPIKE AUTHORITY:

The work consists of the following:

1. Construction of an approximate 6,000 square foot wood-framed building consisting of offices, a crew room with kitchenette, locker and toilet rooms.

2. Construction includes, but is not necessarily limited to, the following:
   The work includes all building structure, mechanical, electrical, and plumbing, as well as all site work, grading, pavement, lighting, utilities, and all other work incidental thereto in accordance with the Plans and Specifications.

3. Construction of reinforced concrete footings, piers, foundation walls, and slabs-on-grade including exterior concrete aprons and entry foundation/slab systems.

4. Construction of the building proper, including all equipment and interior and exterior finishes.

5. Furnishing and installing plumbing, heating, and electrical, complete with all appurtenances and accessories.

6. Coordinating with the utility to provide transformers and connections.

7. Coordinating with the utility to relocate existing underground power and telecom connections to the Police Garage located on the campus, to overhead lines include new poles, service drops to underground conduit and wire, and new underground manholes with spliced connections.

This Work will be done under a Contract known as Contract 2026.07 according to the Plans and Specifications which are on file in the office of the Maine Turnpike Authority, 2360 Congress Street, Portland, Maine.

On the acceptance of this Proposal for said Work, the undersigned will give the required bond with good security conditioned for the faithful performance of said Work, according to said Plans and Specifications, and the doing of all other work required by said Specifications for the consideration herein named and with the further condition that the Maine Turnpike Authority shall be saved harmless from any and all damages that might accrue to any person, persons or property by reason of the carrying out of said Work, or any part thereof, or by reason of negligence of the undersigned, or any person or persons under his employment and engaged in said Work.

The undersigned hereby declares that he/she has carefully examined the Plans, Specifications and other Contract Documents, and that he/she will contract to carry out and complete the said Work as specified and delineated at the price per unit of measure for each scheduled item of Work stated in the Schedule of Prices as follows:

It is understood that the TOTAL AMOUNT stated by the undersigned in the following Schedule of Prices is based on approximate quantities and will be used solely for the comparison of bids, and that the quantities stated in the Schedule of Prices for the various items are estimates only and may be increased or decreased all as provided in the Specifications.

SCHEDULE OF BID PRICES
CONTRACT NO. 2026.07
CROSBY MAINTENANCE OFFICE BUILDING

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
202.203	PAVEMENT BUTT JOINT	SY	75				
202.81	REMOVING STRUCTURES AND OBSTRUCTIONS	Lump Sum	1				
203.20	COMMON EXCAVATION	Cubic Yard	3,350				
203.25	GRANULAR BORROW	Cubic Yard	300				
203.2312	HEALTH AND SAFETY PLAN	Lump Sum	1				
203.2333	DISPOSAL AND TREATMENT OF SPECIAL EXCAVATION	Ton	50				
203.234	TREATMENT OR DISPOSAL OF CONTAMINATED GROUNDWATER	Gallon	500				
203.35	CRUSHED STONE 3/4 INCH	Cubic Yard	150				
304.10	AGGREGATE SUBBASE COURSE - GRAVEL	Cubic Yard	1,100				
304.105	STRUCTURAL FILL	Cubic Yard	1,475				
304.14	AGGREGATE BASE COURSE - TYPE A	Cubic Yard	550				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
403.207	HOT MIX ASPHALT - 19.0 MM NOMINAL MAXIMUM SIZE	Ton	350				
403.208	HOT MIX ASPHALT - 12.5 MM NOMINAL MAXIMUM SIZE	Ton	200				
403.209	HOT MIX ASPHALT - 9.5 MM NOMINAL MAXIMUM SIZE	Ton	50				
409.15	BITUMINOUS TACK COAT RS-1 OR RS1h - APPLIED	Gallon	375				
419.30	SAWCUT AND MILLING BITUMINOUS PAVEMENT	Linear Foot	375				
502.701	CONCRETE EQUIPMENT PAD	Each	1				
502.702	CONCRETE PROPANE TANK PAD	Each	1				
604.15	MANHOLE	Each	1				
604.16	HEAVY DUTY PRECAST JUNCTION BOX/HANDHOLE	Each	5				
604.151	MANHOLE COVER 57" INTERIOR DIAMETER	Each	1				
604.158	UTILITY VAULT - 4' X 6'	Each	2				
605.072	4 INCH PERFORATED SDR-35 UNDERDRAIN	Linear Foot	375				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
606.356	UNDERDRAIN DELINEATOR POST	Each	1				
609.11	VERTICAL GRANITE CURB, TYPE 1	Linear Foot	135				
615.07	LOAM	Cubic Yard	325				
618.14	SEEDING METHOD NUMBER 2	Unit	17				
619.1201	MULCH - PLAN QUANTITY	Unit	17				
619.1202	TEMPORARY MULCH	Lump Sum	1				
620.58	EROSION CONTROL GEOTEXTILE	Square Yard	1,800				
629.05	HAND LABOR, STRAIGHT TIME	Hour	40				
631.12	ALL PURPOSE EXCAVATOR (INCLUDING OPERATOR)	Hour	40				
631.172	TRUCK-LARGE (INCLUDING OPERATOR)	Hour	40				
631.221	SMALL FRONT END LOADER (INCLUDING OPERATOR)	Hour	20				
631.36	FOREMAN	Hour	20				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
633.031	PROPANE SERVICE	Lump Sum	1				
634.1943	4" SCHEDULE 80 PVC CONDUIT	Linear Foot	125				
634.1945	2" SCHEDULE 80 PVC CONDUIT	Linear Foot	925				
634.1946	3" SCHEDULE 80 PVC CONDUIT	Linear Foot	350				
634.3122	#2/0 COPPER WIRE - 12 KV RATED (4 WIRE)	Linear Foot	275				
634.3152	#4 GND WIRE	Linear Foot	275				
				CARRIED FORWARD:			

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
634.3153	#6 GND WIRE	Linear Foot	125				
634.3335	MANHOLE - FIBER OPTIC - STANDARD	Each	1				
639.19	FIELD OFFICE - TYPE B	Each	1				
656.656	EROSION CONTROL FILTER BERM	Cubic Yard	250				
659.1	MOBILIZATION	Lump Sum	1				
670.11	**SUBSURFACE WASTEWATER DISPOSAL SYSTEM**	**Lump Sum**	**1**				
				CARRIED FORWARD:			

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
800.01	CROSBY MAINTENANCE BUILDING	Lump Sum	1				
801.14	4 INCH PVC SANITARY SEWER	Linear Foot	15				
822.322	6 INCH CLASS 52 DUCTILE IRON WATER MAIN	Linear Foot	30				
822.34	8 INCH CLASS 52 DUCTILE IRON WATER MAIN	Linear Foot	500				
823.325	8 INCH GATE VALVE	Each	5				
823.331	6 INCH GATE VALVE	Each	1				
824.32	REMOVE/RESET HYDRANT	Each	1				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
825.349	**TERMINATE WATER SERVICE**	**Each**	**2**				
825.4222	2 INCH GATE VALVE QITH BOX	Each	3				
825.4222	2 INCH HDPE CTS	Linear Foot	250				
825.4311	1 1/2 INCH HDPE CTS	Linear Foot	75				
TOTAL:							

Acknowledgment is hereby made of the following Addenda received since issuance of the Plans and Specifications: _____

_____

_____

Accompanying this Proposal is an original bid bond, cashiers or certified check on _____ Bank, for _____, payable to the Maine Turnpike Authority. In case this Proposal shall be accepted by the Maine Turnpike Authority and the undersigned should fail to execute a Contract with, and furnish the security required by the Maine Turnpike Authority as set forth in the Specifications, within the time fixed therein, an amount of money equal to Five (5%) Percent of the Total Amount of the Proposal for the Contract awarded to the undersigned, but not less than $500.00, obtained out of the original bid bond, cashier's or certified check, shall become the property of the Maine Turnpike Authority; otherwise the check will be returned to the undersigned.

The performance of said Work under this Contract will be completed during the time specified in Subsection 107.1.

It is agreed that time is of the essence of this Contract and that I (we) will, in the event of my (our) failure to complete the Work within the time limit named above, pay to Maine Turnpike Authority liquidated damages in the amount or amounts stated in the Specifications.

The undersigned is an Individual/Partnership/Corporation under the laws of the State of _____, having principal office at _____, thereunto duly authorized.

_____ *(SEAL)*

_____ *(SEAL)*

Affix Corporate Seal
or Power of Attorney
Where Applicable

_____ *(SEAL)*

By: _____

Its: _____

Information below to be typed or printed where applicable:

INDIVIDUAL:

(Name)	(Address)

PARTNERSHIP - Name and Address of General Partners:

(Name)	(Address)
(Name)	(Address)
(Name)	(Address)
(Name)	(Address)

INCORPORATED COMPANY:

(President)	(Address)
(Vice-President)	(Address)
(Secretary)	(Address)
(Treasurer)	(Address)

SECTION 033500 - POLISHED CONCRETE

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 SECTION INCLUDES

A. Sealer, hardener and polishing for cast-in-place concrete slabs.

1.3 RELATED SECTIONS

A. Section 033000 - Cast-in-Place Concrete for smooth steel troweled slabs to receive polished concrete finish.

1.4 REFERENCES

A. ASTM International (ASTM):
   1. ASTM C779: Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
   2. ASTM G23-81: Ultraviolet Light and Water Spray.
   3. ASTM C805: Impact Strength.

B. American Concrete Institute (ACI): ACI 302 1R-89 - Guide for Concrete Floor and Slab Construction.

1.5 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Manufacturer's specifications and test data.
   2. Special concrete finishes describing product to be provided, giving manufacturer's name and product name for the specified material proposed to be provided under this section.
   3. Manufacturer's recommended installation procedures; which when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
   4. Special concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.

C. Test Reports: Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Use an experienced installer and adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
   2. Provide letter of certification from concrete finish manufacturer stating that installer is

a certified applicator of special concrete finishes, and is familiar with proper procedures and installation requirements required by the manufacturer.

3. Applicator shall be familiar with the specific requirements and the methods needed for proper performance of work of this Section.

B. Mock-Up: Provide a mock-up for evaluation of workmanship and appearance.

1. Apply mock-up of finish, to demonstrate typical joints, surface finish, color variation (if any), and standard of workmanship.
   a. Build mock-up approximately 50 square feet in the location indicated or if not indicated, as directed by the Architect.
   b. Notify Architect seven days in advance of dates and times when mock-ups will be constructed.
   c. Obtain from the Architect approval of mock-ups before starting construction.
   d. If the Architect determines that mock-ups do not meet requirements, demolish and remove them from the site and cast others until mock-ups are approved.
   e. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
   f. Approved mock-ups may become part of the completed work if undisturbed at time of substantial completion.

C. Pre-Installation Conference:

1. Conduct conference at project site with Architect, Owner, and Installer.
   a. Review application procedures and finishing requirements.
   b. Inspect mock-up and review acceptable characteristics and sheen.
   c. Review scheduled work to be conducted in space after floor finishing is completed. Review protection, cleaning and repair procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Deliver materials in original containers, with seal's unbroken, bearing manufacturer labels indicating brand name and directions for storage.

1.8 WARRANTY

A. Provide manufacturer's 10 year limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design (SC): RetroPlate Concrete Polishing System, which is located at: P. O. Box 50533; Provo, UT 84605; Web: retroplatesystem.com; Area Representative: Ed Leach (978)697-1951.

B. Finish Appearance:

1. Aggregate Exposure: Class A, Cement Fines.
2. Color: Onyx.
3. Gloss: Level 1 Flat.

C. Stain: RetroPlate Concrete Dye, Helix Color System, added to diluent acetone base to

maximize dye penetration.

2.2 HARDENING/SEALING AGENT

A. Product: Retro Plate 99 by Ashford Formula, By Curecrete. Product shall be a chemical reactive concrete stabilizer which enhances the concrete density and hardness allowing the concrete to be finished to a high cosmetic marble like sheen. Nonflammable, water-based, nontoxic. Meets USDA and VOC compliance.

B. Performance Criteria:
   1. Abrasion Resistance: ASTM C779 - Up to 400 percent increase in abrasion resistance.
   2. Impact Strength: ASTM C805 - Up to 21 percent increase impact strength.
   3. Ultra Violet Light and Water Spray: ASTM G23 - No adverse effect to ultra violet and water spray.
   4. Reflectivity: Up to 30 percent increase in reflectivity.
   5. Co-efficient of Friction: All levels of finish to exceed OSHA and ADA recommendations for wet and dry hard surfaces.

C. Neutralizing Agent: Tri-sodium phosphate.

D. Water: Potable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

B. Verify that base slab meet finish and surface profile requirements in Division 03 Section Cast-In-Place Concrete.

C. Prior to application, verify that floor surfaces are free of construction laitance.

3.2 PREPARATION

A. Protection:
   1. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.
      a. All hydraulic powered equipment shall be diapered to avoid staining of the concrete.
      b. No trade shall park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths shall be placed under vehicles at all times.
      c. No pipe cutting machine shall be used on the inside floor slab.
      d. Steel shall not be placed on interior slab to avoid rust staining.
      e. Acids and acidic detergents shall not come into contact with slab.
      f. All trades informed that the slab shall be protected at all times.

B. Environmental Limitations:
   1. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions

affecting topping performance.

a. Concrete shall be cured a minimum of 45 days or as directed by the manufacturer before application can begin.
b. Application shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.

C. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

3.3 APPLICATION

A. Start of the floor finish applications shall be in the presence of manufacturer's technical representative.

B. Grind floor to provide smooth uniform finish, free of marks and scratches, providing specified level of surface finish.

C. Apply dye to surface in multiple uniform application coats to match approved color.

D. Follow manufacturer's installation instructions. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

E. Sealing, Hardening and Polishing of Concrete Surface:
1. Concrete shall be in place a minimum of 45 days or as directed by the manufacturer before application can begin.
2. Application shall take place at least 10 days prior to racking and other in-store accessory installation, providing a complete, uninhibited concrete slab for application
3. Applicable procedures shall be followed as recommended by the product manufacturer and as required to match approved test sample.
4. Achieve waterproofing, hardening, dust-proofing, and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
5. Polish to required sheen level.

3.4 WORKMANSHIP AND CLEANING:

A. The premises shall be kept clean and free of debris at all times. Remove spatter from adjoining surfaces, as necessary. Repair damages to surface caused by cleaning operations.

B. Remove debris from jobsite. Dispose of materials in separate, closed containers in accordance with local regulations.

3.5 PROTECTION:

A. Protect finished work until fully cured in accordance with manufacturer's recommendations.

END OF SECTION 033500

SECTION 064000 - ARCHITECTURAL WOODWORK

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, but is not limited to, the following:
   1. Plastic-laminate cabinets.
   2. Solid-surfacing-material countertops.

B. Related Sections include the following:
   1. Division 06 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 22 Sections for plumbing integrated into casework.
   3. Division 26 Sections for conduit, wiring, and lighting integrated into casework.

1.3 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.

C. Semiexposed 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 "semiexposed."

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."

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each type of product indicated, including cabinet hardware and accessories, and finishing materials and processes.
   1. For installation adhesives and sealants, include a printed statement of the VOC content.

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, grommets and other items installed in architectural woodwork.
4. Show veneer grain direction.

D. Samples for Verification: For the following:
1. Lumber with or for transparent finish (stained), 5 inches wide by 24 inches long, for each species and cut, finished on 1 side and 1 edge.
2. Wood-veneer-faced panel products with transparent finish (stained), 8 by 10 inches, 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 inches, for each type, color, pattern, and surface finish.
4. Solid-surfacing materials, 6 inches 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 specified 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.

1.5 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. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork.

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

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 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.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and 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.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions. √

1.8 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.

B. Coordinate locations and sizes of plumbing fixtures that will penetrate countertops.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI's standards for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Products: Comply with the following:
   1. Hardboard: AHA A135.4.
   2. Medium-Density Fiberboard, MDF: ANSI A208.2, Grade MD-21, 48 lb. density.
   3. Particleboard: Industrial grade ANSI A208.1, Grade M-2, exterior glue.
   4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
   5. Hardwood Plywood and Face Veneers: HPVA HP-1, Grade A veneers.
      a. Species: Select white maple, plain sawn or sliced.
      b. Veneer Core Construction, All Locations Except as Noted: Veneer core plywood, no voids; poplar or baltic birch core veneers.
         1) 1/2-Inch Thickness: 5 plies.
         2) 3/4-Inch Thickness: 7 plies.
         3) 1-Inch Thickness: 9 plies.

c. Veneer Core Construction for Door Fronts, Drawer Fronts and Paneling: Particleboard or MDF core.

C. High-Pressure Decorative Laminate (Plastic Laminate), PLAM1, grades as indicated, or if not indicated, as required by woodwork quality standard.
1. Product: Panolam Industries International, Inc.; Pionite.
2. Colors, Patterns, and Finishes: As indicated on Materials Legend.
a. High-Pressure Decorative Laminate (Plastic Laminate) for Semi-Exposed Surfaces (Cabinet Interiors): Color as selected by Architect.

D. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick, with radiused edges. Hot melt machine applied adhesive application.
1. Provide T-molding at locations indicated (Lecture tables).

E. Solid-Surfacing Material, SS1: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
1. Product: Corian; DuPont Polymers
a. Color, Pattern, and Finish: As indicated in Materials Legend.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.
1. Do not use treated material that does not comply with requirements of referenced woodworking standard or that is warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

2.3 CABINET HARDWARE

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware."

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

C. Butt Hinges: 2-3/4-inch, 5-knuckle steel hinges made from 0.095-inch- thick metal with antifriction bearings and rounded tips, and as follows:
1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521, Grade 1.
2. Provide 2 for doors less than 28 inches high; 3 for doors 28 to 60 inches high; and 4 hinges for doors more than 60 inches high.

D. Wire Pulls: Back mounted, 4 inches long, 5/16 inch in diameter, stainless steel.
1. Manufacturers: Ives or Stanley.

E. Catches: Provide 2 catches on doors more than 48 inches high.
1. Heavy-duty magnetic catches, BHMA A156.9, B03171.
a. Product: Catch No. 918; Knape & Vogt Mfg. Co.

2. Heavy duty roller catches with conical spring and full lip strike.
   a. Product: Roller latch No. 335; H. B. Ives.

F. Shelf Rests: BHMA A156.9, B04013.
1. Plastic Shelf Rest: Polycarbonate resin, heavy-duty double pin shelf rest with shelf lock for 5 mm diameter drilled holes spaced at 32 mm o.c.; shelf lock shall accommodate 3/4-inch thick and 1-inch thick shelves; and capable of supporting up to 500 lbs.
   a. Product: Allen Field Manufacturing & Development; HD Double Pin No. 55536.

G. Drawer Slides: Side-mounted, full-extension, 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.
2. File Drawer Slides: 150 lbf.

H. Drawer and Cupboard Locks: Cylindrical type, 5-pin tumbler and cam, brass with chrome-plated finish, complying with BHMA A156.11, Grade 1.
1. Timberline; CompX deadbolt door locks; tall cabinets System 260.
2. Provide minimum of 4 keys per room that has cabinets with locks and 8 master keys.
3. Each room shall be keyed according to Owner's instructions. Provide locks on all drawers and doors.
   a. Provide barlock multipoint locks for tall cabinets.

I. Undermount Sink Clips: Perforated base with threaded stud for adhesive attachment to the underside of solid surface countertops, sink clips, washers and wing nuts for securing sink.
1. EZ Undermount Sink Clips.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
2. Satin Stainless Steel: BHMA 630.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 CABINET ACCESSORY MATERIALS

A. Counter Bracket Supports: Fabricated of 6063 T-6, T-shaped extruded aluminum; MIG welded along 45 degree miters and along back; pre-punched for 1/4-inch fasteners; provide rubber grommet in 7/8-inch hole; powder coated finish.
1. Size: Varies as required for condition; coordinate with Drawings.
2. Mounting Style: Exposed and concealed (in wall) mounting; coordinate with Drawings.
3. Product: Rakks, Rangine Corp., Millis, MA.

B. ADA Sink Base Bracket Support: Fabricated of 6063 T-6, T-shaped extruded aluminum; MIG welded along 45 degree miters and along back; pre-punched for 1/4-inch fasteners; provide rubber grommet in 7/8-inch hole; powder coated finish.
1. Size: Custom sizes as required for condition; coordinate with Drawings.
2. Product: Rakks EHV Vanity Support; Rangine Corp., Millis, MA.

2.5 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Screws: Select material, type, size, and finish required for each use and substrate. Comply with ASME B 18.6.1 for applicable requirements.
   1. For metal framing supports, provide screw as recommended by metal-framing manufacturer.

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.

2.6 FABRICATION, GENERAL

A. Interior Woodwork Grade: Provide materials that comply with requirements of the AWI's quality standards for each type of woodwork and quality grade indicated and any additional requirements of this Section. 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 3/4 Inch Thick or Less: 1/16 inch.
   2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 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.

2.7 PLASTIC-LAMINATE CABINETS

A. Quality Standard: Comply with AWI's Standards, Section 10 - Casework and additional specified requirements for plastic 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: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.

E. Materials for Semiexposed Surfaces: Provide surface materials indicated below:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
   2. Drawer Sides and Backs: Solid-hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood.

F. Base Cabinets: Bottoms and ends of cabinets, exposed backs, and tops of cabinets; 3/4-inch particleboard, high-pressure decorative plastic laminate faced on exposed surfaces, high-pressure decorative laminate faced on semi-exposed surfaces.
   1. Backs of Cabinets: 1/2-inch particleboard, high-pressure decorative laminate faced. Back mounted to side, bottom and top; inset 3/4-inch to conceal mounting rails. Tall cabinets shall have rails positioned at top and intermediate location. Base cabinet shall have rail positioned at the top.
   2. Mounting Rails: 3/4-inch thick, fastened to cabinet back on interior of cabinet or as indicated in details.
   3. Cabinet Sub-Base: Separate and continuous (no cabinet body sides to floor), water resistant exterior grade plywood with concealed fastening to cabinet bottom. Ladder type construction of front, back, and intermediates to form a secure and level platform to which cabinets attach.
   4. Depth: Provide cabinets of the type indicated meeting the following:
      a. Deep Cabinet: Minimum outside depth of 23 inches from wall to face of cabinet box, less the door (approximately 24 inches from wall to face of door).
      b. Shallow Cabinet: Minimum outside depth of 13 inches from wall to face of cabinet box, less the door (approximately 14 inches from wall to face of door).

G. Wall Cabinets: Ends of cabinets and exposed backs; 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, high-pressure decorative laminate faced on semi-exposed surfaces. Tops and bottoms of cabinets; 1-inch particleboard, high-pressure decorative laminate faced.
   1. Backs of Cabinets: 1/2-inch particleboard, high-pressure decorative laminate faced surfaces with balance sheet on concealed side. Back mounted to side bottom and top, inset 3/4 inch to conceal mounting rails. Cabinets shall have rails positioned at top and bottom location.
   2. Mounting Rails: 3/4-inch thick, fastened to back of cabinet on interior of cabinet or as indicated in details.
   3. Depth: Wall hung cabinets shall have a minimum outside depth of 13 inches from wall to face of cabinet box, less the door (approximately 14 inches from wall to face of door).

H. Inside Corners: Construct cabinets and fillers at inside corners to allow for proper clearance and operation of drawers and doors.

I. Drawer Fronts: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, high-pressure decorative laminate faced on semi-exposed surfaces, applied to separate drawer body sub-front.

J. Drawer Bodies: 1/2-inch thick MDF or plywood sides, back, and sub-fronts with dadoed, pinned and glued joints. MDF bottom, 1/4- inch thick, rabbeted into sides, back and sub-front, and glued. All surfaces inside and outside of drawer box shall be covered with high-pressure decorative laminate finish. Reinforce drawer bottoms with 1/2- by 4-inch front to back hardwood intermediate stiffeners, glued and fastened in place. Provide one stiffener for drawers to 24 inch width, two to 36 inch width and four to 48 inch width.

K. Solid Doors: 3/4-inch thick particleboard or medium-density fiberboard, high-pressure decorative laminate faced on exposed and semi-exposed surfaces.

L. Shelving: Particleboard or medium-density fiberboard meeting the following:
1. Open Shelving: 1-inch thick shelving for all widths, unless otherwise indicated. Top of shelves faced with plastic-laminate. Underside of shelves, high-pressure decorative laminate faced.
2. Behind Solid Doors: 3/4-inch thick for cabinets up to 24 inches wide. 1 inch thick shelving for cabinets greater than 24 inches wide. High-pressure decorative laminate faced.
3. All shelving shall be adjustable. Fixed center shelf for tall units to prevent bowing of cabinet sides.

M. Edgebanding: Color to match surfacing material. Finished edgebanding shall be uniform in color and sheen.
1. Exposed and Semi-Exposed Shelving: 3 mm PVC applied to front edge. 1 mm PVC applied to back edge and both ends.
2. Doors and Drawer Fronts: 3 mm PVC applied to perimeter, matching face laminate.
3. Drawer Bodies: 1 mm PVC applied to all edges, semi-exposed and concealed locations (top, back and bottom edges).
4. Cabinet Bodies: 1 mm PVC applied to all exposed and semi-exposed edges, matching face laminate.
5. Dividers: 1 mm PVC.

N. Removable Panels at Handicap Sink Bases: High-pressure decorative laminate on particle board made with exterior glue with melamine or plastic laminate cabinet liner of back side; 3 mm PVC edgebanding applied to edges. Provide tamper-resistant screws with finishing cup washers for attaching panels to concealed cleats.
1. Panel Thickness: 3/4-inch.

O. Colors, Patterns, and Finishes: As indicated in Interior Materials Legend.
1. Color for cabinet interior as selected by Architect.

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Quality Standard: Comply with AWI's Standards Section 11 - Countertops requirements for countertops.

B. Grade: Custom.

C. Configuration: Provide countertops with the following front and backsplash style:
   1. Front: Straight, 1/4-inch radius at top.
   2. Backsplash: Provide integral cove where backsplash meets the top, chemically bonded. Flat, slightly eased at corner for top of backsplash, 3/4-inch- thick, with scribe edge.
   3. Endsplash: Matching backsplash.

D. Solid-Surfacing-Material Thickness: 1/2 inch with front edge built up with same material.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
   1. Match color, pattern, and finish as indicated by manufacturer's designations for these characteristics.

F. Fabrication: Fabricate tops in one piece with integral chemically bonded shop-applied edges and backsplashes. Provide continuous 3/8-inch deep scribe strip along top back edge and ends of back splash. Provide built-up nosing with concealed drip groove. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose endsplashes for field assembly.
   2. Provide continuous aprons at locations indicated.

G. At locations indicated, provide clear anodized aluminum reveal at edges of countertop support.

H. Drill holes in countertops for plumbing fittings and grommets in shop.

2.9 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 backpriming.

C. Install plywood backers to walls indicated to receive wood trim and wall panels.

2.10 INSTALLATION

A. Quality Standard: Install woodwork to comply with 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. Cabinets and Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   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.
   3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   3. Scribe back splashes to conform to wall.
   4. Install loose end splashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing. Set back edge in bed of sealant to prevent water from running behind splash. Adhere to wall with construction adhesive. Adhere bottom edge to top with solid surface adhesive system to form a continuous water tight joint. Do not use exposed silicone sealant along bottom edge.
   5. Install countertop brackets specified in Part 2. Painting of bracket specified in Division 09 Section "Painting."
   6. Provide cutouts for plumbing fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal surfaces of cutout edges.
   7. Caulk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

2.11 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 semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

2.12 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 time of Substantial Completion.

END OF SECTION 064000

SECTION 074113 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Standing-seam metal roof panels.
   2. Flat-seam metal soffit panels.

B. Related Sections:
   1. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, insulation, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
   1. Test-Pressure Difference: Negative 1.57 lbf/sq. ft..
   2. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft..
   3. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
   4. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

D. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
   1. Test-Pressure Difference: 2.86 lbf/sq. ft..
   2. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. and not more than 12.0 lbf/sq. ft..

3. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
4. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: UL 90.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. 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.

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 roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
a. Flashing and trim.
b.

C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.
2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch- long Samples for each type of accessory.

E. Delegated-Design Submittal: For metal roof 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.
1. Snow Retention System Calculations: Include calculation of number and location of snow guards based on snow load, roof slope, panel length and finish, and seam type and spacing.

F. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installers of the items involved:
   1. Roof panels and attachments.
   2. Roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, snow guards, and items mounted on roof curbs.

G. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.
   1. Submit evidence of meeting performance requirements.

H. Qualification Data: For qualified Installer.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

J. Field quality-control reports.

K. Maintenance Data: For metal roof panels to include in maintenance manuals.

L. Warranties: Samples of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.

D. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
   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 roof panel installation, including manufacturer's written instructions.
   4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   5. Review structural loading limitations of deck during and after roofing.
   6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
   7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
   8. Review temporary protection requirements for metal roof panel assembly during and after installation.
   9. Review roof observation and repair procedures after metal roof panel installation.
   10. 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 roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.

B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of decks, parapets, walls, 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 metal roof 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, metal finishes, 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 roof 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.

C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness 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. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
2. Surface: Smooth, flat finish.
3. Exposed Coil-Coated Finish:
   a. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
4. 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. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet (Waterproof Underlayment): 30 to 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
   b. CETCO; StrongSeal SA.
   c. Grace Construction Products; a unit of Grace, W. R. & Co.; Ice & Water Shield HT.

d. Henry Company; Blueskin PE200 HT.
e. Metal-Fab Manufacturing, LLC; MetShield.

B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.3 MISCELLANEOUS MATERIALS

A. Panel 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 roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

B. 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.

C. Molded Polystyrene Insdulation Board, Type IX: ASTM C 578, Type IX, 25-psi minimum compressive strength.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Insulfoam LLC; a Carlisle company.

2.4 CONCEALED-FASTENER, LAP-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Standing-Seam-Profile, Concealed-Fastener Metal Roof Panels: Formed with raised, curved-top, standing-seam-shaped major rib at panel edge and flat pan between major rib and panel edge.
1. Basis-of-Design Product: Subject to compliance with requirements, provide SLR 12” and 18” by Morin or comparable product by one of the following:
a. Cheney Flashing Company.
b. Copper Sales, Inc.
c. Dimensional Metals, Inc.
d. Englert, Inc.
e. Firestone Metal Products.
f. Metal Fab Manufacturing.
g. Metal Sales Manufacturing Corporation.
2. MaterialAluminum-zinc alloy-coated steel sheet, 24 gage nominal thickness.
a. Exterior Finish: 2-coat fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.
3. Panel Coverage:
a. Main Roofs: 18 inches.
4. Panel Height: 1.5 inches.

2.5 ACCESSORIES

A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
   1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
   2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
   3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

B. Flashing and Trim: Formed from same material and thicknessas roof panels. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

2.6 FABRICATION

A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Flat-Seam Soffit: Form flat-seam panels from metal sheets with 1/2-inch notched and folded edges.

D. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.

E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the 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. End Seams for Other Than Aluminum: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
   4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

5. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.7 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: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.

B. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

C. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

D. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

E. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
   1. Over roof areas indicated on the drawings.

B. Felt Underlayment: Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches.
   1. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches, in shingle fashion to shed water.

C. Apply slip sheet over underlayment before installing metal roof panels.

D. Install flashings to cover underlayment to comply with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim."

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

A. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

B. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.
   1. Point of Fixity: Fasten each panel along a single line of fixing located at center of panel length.
   2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.

C. Install metal roof panels as follows:
   1. Commence metal roof panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
   2. Field cutting of metal panels by torch is not permitted.
   3. Install panels perpendicular to purlins.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Provide metal closures at rake edges.
   6. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
   7. Install ridge caps as metal roof panel work proceeds.
   8. End Splices: Locate panel end splices over, but not attached to, structural supports. Stagger panel end splices to avoid a four-panel splice condition.
   9. Install metal flashing to allow moisture to run over and off metal roof panels.

D. Fasteners:
   1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.

E. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

F. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
   1. Coat back side of roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.

G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
   1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
   1. Install clips to supports with self-tapping fasteners.
   2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
   3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

B. Flat-Seam Soffit: Attach flat-seam metal panels to substrate with cleats, starting at eave and working upward toward ridge. After panels are in place, mallet seams tight and solder.
   1. Attach roofing panels with cleats spaced not more than 24 inches o.c. Lock and solder panels to base flashing.
   2. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at 12-inch o.c. spacing. Lock panels to edge flashing and apply sealant.

3.6 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 roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, 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).

C. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Adhered ethylene-propylene-diene-monomer (EPDM) roofing system.
2. Substrate board.
3. Vapor retarder.
4. Roof insulation.
5. Roof accessories, including expansion joints, and walkways.
6. Protection sheet.

B. Related Requirements:
1. Division 07 Section 070800 "Building Envelope Commissioning" for Contractor's responsibilities in commissioning of building enclosure and coordination with Owner's commissioning agent..
2. Division 06 Section "Rough Carpentry" for material description and installation requirements for wood nailers and blocking.
3. Division 07 Section "Fluid-Applied Air/Vapor Barrier System" for tie-in with roof system.
4. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

C. Products installed, but not furnished, under this Section include the following:
1. Installation of counterflashing portion of two-piece counterflashing furnished under Division 07 Section "Sheet Metal Flashing and Trim."

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

B. 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.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site. Review methods and procedures related to roofing system including, but not limited to, the following:
   1. Meet with Owner, Architect, Owner's commissioning agent, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing.
   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. Review protection of building occupants and air handlers from adhesive fumes during roof installation.
   5. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   6. Review structural loading limitations of roof deck during and after roofing.
   7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
   8. Review governing regulations and requirements for insurance and certificates if applicable.
   9. Review construction schedule to minimize construction activities on completed roofing.
   10. Review temporary protection requirements for roofing system during and after installation.
      a. Review staging, material placement, construction activity and pedestrian traffic protection requirements for work areas and access paths to areas where work will occur on completed roofing.
   11. Review roof observation and repair procedures after roofing installation. Establish monitoring procedures for construction activities and recording of damage by sub-trades.
   12. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
   13. Provide 7 business days minimum advance notice to participants prior to convening preinstallation conference.

B. Building Envelope Commissioning: Participate in building envelope commissioning pre-construction meeting and progress meetings as required by the Contractor and the Commissioning Agent.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work. Customized detail sheets shall be prepared showing each condition and approved installation method conforming to construction drawing constraints and details. Provide the following:
   1. Base flashings and membrane terminations.
   2. Layout of tapered insulation and cricket materials, including slopes.
   3. Roof plan showing orientation of steel roof deck and orientation of roofing and fastening spacings and patterns for mechanically fastened roofing.
   4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

5. Roof flashing details shall be consistent with those shown on 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.
6. Tie-in with air/vapor barrier system.

C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Installer Qualification Data: For qualified Installer signed by roofing system manufacturer certifying that Installer factory trained and licensed by manufacturer to install roofing system.

B. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified, independent testing agency, for components of roofing system.
1. Insulation Test Reports: Include insulation test reports evidencing compliance with specified requirements including those for thermal resistance, fire test response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

C. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

D. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Warranty Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Warranties: Special warranties specified in this Section.

1.8 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 special warranty. Contractor shall have a minimum of 5 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 membrane roofing including, but not limited to, insulation, flashing, and membrane sheet joint sealers, shall be performed by Installer of this Work.

B. 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.

C. Warranty Inspection: Upon completion of the installation, an inspection shall be made by the roofing system manufacturer to ascertain that the roofing system has been installed according to applicable manufacturer's specifications and details. No "early bird" warranty will be accepted. Results of the warranty inspection shall be submitted in writing to Owner and Architect for their review and records.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life of liquid materials, approval or listing agency markings, and manufacturer's written instructions for storing and mixing with other components. Comply with manufacturer's written instructions for proper material storage.

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. Replace discarded materials at no additional cost to Owner.

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.
   1. Insulation and cover board shall be stored on pallets, not less than 4 inches off ground, tightly covered with waterproof, "breathable" materials. Protect insulation from direct sunlight.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.
   1. Do not overload any portion of building, either by use of or placement of equipment, storage of debris, or storage of materials. Construction loads shall not exceed 25 pounds per square foot.

E. Materials shall be delivered in sufficient quantity to allow continuity of Work.

F. Materials, which are damaged or beyond their stated shelf life, shall be removed and replaced at Installer's expense.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
   1. Weather protection shall mean the temporary protection of that work adversely affected by moisture, wind, heat, and cold by covering, patching and sealing, enclosing, ventilation, cooling and/or heat.

B. Proceed with work so roofing materials are not subject to construction traffic. When construction traffic is necessary, roof sections shall be protected with plywood or other appropriate material to prevent damage; remove protection after construction traffic has ceased and re-inspected for possible damage to roofing.

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 roof or in substrate materials.

D. Temporary Water Stops: Install at end of each workday and remove before proceeding with 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 roofing application. Remove debris at completion of each day's work and clean drains, if required. At completion, test drains to ensure 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. Protect roofing at access locations, work areas and construction traffic locations with plywood or other appropriate material to prevent damage to roof system. Remove upon completion of Work.

H. If exterior walls are not erected at time of membrane installation, envelop flutes of metal deck to prevent moisture intrusion and wind damage.

I. Coordinate shut down or covering of air-handling ducts whenever possible during roofing activities to prevent fumes from adhesives from entering the building. The covering or shut-down of air-handling ducts shall be approved by the Owner prior to starting the work.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard or customized 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 measured at 10 meters above ground level. Warrantor shall be the manufacturer of the roofing membrane. Warranty shall be written to building Owner.
   1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate boards, roofing accessories, walkway products, and other components of roofing system.
   2. Warranty Period: 20 years from date of Substantial Completion.

B. When the Warrantor is notified that there is a problem (leak or damage) with warranted roofing system and/or accessories by telephone, and/or in writing (fax, e-mail or mail), the response time to physically start repairs shall be within twenty-four hours from time of telephone or date of written notification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components including roof insulation, cover board, substrate boards, vapor barriers and fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer for a total system warranty.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
   1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
   2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressures calculated according to **IBC 2021** and **ASCE 7-16** as follows:
   1. Reference structural drawing S00-1 for wind load design criteria.
   ~~2. Ultimate Wind Speed: 120 MPH (3 Second Gust).~~
   ~~3. Exposure Category: B.~~
   ~~4. Roof Zone 1 - Field of Roof: Negative 26.8 psf and positive 16 psf.~~
   ~~5. Roof Zone 2 - Perimeter (11.5 Feet from Roof Edge): Negative 36 psf and positive 16 psf.~~
   ~~6. Roof Zone 3 - Corner (11.5 Feet from Corner in Each Direction): Negative 43.3 psf and positive 16 psf.~~

D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

E. 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.

2.3 ROOF SYSTEM ASSEMBLIES

A. Fully Adhered EPDM Roof System Assembly, Roof System R1: Fully adhered roof membrane adhered to top layer of insulation. Mechanically fastened rigid insulation layers shall be installed over vapor retarder adhered to metal deck.

B. Fully Adhered EPDM Roof System Assembly, Roof System R2: Fully adhered roof membrane adhered to tapered insulation. Mechanically fastened tapered and rigid insulation layers shall be installed over vapor retarder adhered to metal deck.

C. Fully Adhered EPDM Roof System Assembly, Roof System R3: Fully adhered roof membrane adhered to rigid and tapered insulation. Rigid and tapered insulation mechanically fastened to the metal deck.

D. Fully Adhered EPDM Roof System Assembly, Roof System R4: Fully adhered roof membrane adhered to tapered insulation. Tapered insulation adhered to rigid insulation shall be adhered to vapor barrier. Vapor barrier shall be installed on substrate board that is adhered to concrete deck.

E. Fully Adhered EPDM Roof System Assembly, Roof System R5: Fully adhered roof membrane adhered to top layer of insulation. Vapor barrier shall be installed on substrate board mechanically fastened to acoustical metal deck. Fasteners shall not project below bottom of roof deck. Rigid insulation shall be adhered to vapor barrier. Second layer of roof insulation adhered to bottom layer. Tapered insulation adhered to rigid insulation
   1. Install acoustical insulation into deck flutes before installation of substrate board.

F. Fully Adhered EPDM Roof System Assembly, Roof System R8 (Outbuildings – See A10-14 and A10-15): Fully adhered roof membrane adhered to cover board. Cover board mechanically fastened to plywood deck.

2.4 EPDM ROOFING

A. EPDM: ASTM D 4637, Type I, nonreinforced, uniform, flexible EPDM sheet, providing Class A exterior rating.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carlisle SynTec Incorporated.
      b. Firestone Building Products.
      c. Versico Incorporated.
   2. Thickness: 60 mils, nominal.
   3. Exposed Face Color: Black.
   4. Outbuildings Pitched Roofs: Provide 90 mil FR membrane.

2.5 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55- to 60-mil-thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.
   1. Provide around new kitchen exhaust hoods; extend not less than 10 feet from all sides of exhaust hood.

D. Bonding Adhesive: Manufacturer's standard capable of withstanding Project wind uplift requirements.

E. Seaming Material: Manufacturer's standard splice tape for sealing lapped joints, including edge sealer to cover exposed spliced edges as recommended by membrane manufacturer.

F. Lap Sealant: Manufacturer's standard, single-component sealant.

G. Membrane Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand specified uplift force.

H. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

I. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

J. Crickets and Flashing Accessories: Types recommended by membrane manufacturer, including adhesive tapes, flashing cements, and sealants.
   1. Crickets: Tapered factory pre-cut crickets, extending to roof drain sumps, 1/2-inch taper.

K. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
   1. Fasteners into Preservative Treated Lumber: Stainless steel only.

L. Miscellaneous Accessories: Provide preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
   1. Pourable sealers not allowed.
   2. Field-formed pipe flashing not allowed.

M. Expansion Joint Bulb: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible, closed-cell polyethylene foam, nonabsorbent to liquid water and gas; size as needed to meet expansion joint conditions.

N. Insulation Retainer and Insulation for Expansion Joints:
   1. Insulation Retainer: Continuous EPDM sheet, minimum 45-mil thickness, with sealed seams.
   2. Insulation: Unfaced, mineral wool blanket (batt) insulation, ASTM C 665, Type I; consisting of fibers bonded with thermosetting resin; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics
      a. R-Value: Not less than R-21.

O. Roof Walkways: Shall be premolded 30 inch wide rubber walkways supplied by membrane manufacturer.

2.6 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate board,minimum 1/4 inch thick.
   1. Moisture- and Mold-Resistance: ASTM D 3273, rating of 10.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Georgia-Pacific Corporation; DensDeck Roof Board.
      b. National Gypsum Company; DEXcell Glass Mat Roof Board.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate panel to roof deck.
   1. Fasteners for substrate board over acoustical deck shall be sized to resist project wind pressures without penetrating below bottom deck flute.

2.7 VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder (Barrier): ASTM D 1970, Class I vapor barrier; composite sheet comprised of SBS modified bitumen adhesive, factory laminated to a tri-laminate woven, high-density, slip-resistant top layer with a release liner.
   1. Tensile Strength: ASTM D 412, 250 psi.
   2. Vapor Permeability: ASTM D 1970, 0.015 perms.
   3. Air Permeance: ASTM E 2178, less than 0.002 L/s/m^2.
   4. Products:
      a. Carlisle SynTec Inc.; VapAir Seal MD Air and Vapor Barrier.
      b. Firestone Building Products Co.; V-Force Vapor Barrier Membrane.
      c. Versico Inc.; VAPAIR Seal MD Air & Vapor Barrier.

B. Primer for Self-Adhering-Sheet Vapor Retarder (Barrier): Manufacturer's recommended primer for substrate board.

2.8 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by EPDM roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, Grade 2, 20 psi, glass-fiber mat facer on both major surfaces.
   1. Thickness:
      a. At Pitched Steel Locations: 2 layers of 3 inch thick insulation for a total thickness of 6 inches.
      b. At Flat Steel and Future Classroom Locations Roof Type R2 and R4: 1 layer of 3.7 inch thick insulation covered with tapered insulation; average insulation thickness shall be not less than 6 inches.
   2. Products:
      a. Carlisle SynTec Inc.; SecurShield Polyiso Insulation.
      b. Firestone Building Products Co.; ISO 95+ GL Insulation.
      c. Versico Roofing Systems; SecurShield Polyiso Insulation.

3. Provide roofing manufacturer's required insulation for total system warranty.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
   1. Tapered insulation shall meet requirements specified for board roof insulation. Provide tapered boards where indicated.
   2. Tapered insulation shall be manufactured by same manufacturer of board roof insulation.
   3. Provide roofing manufacturer's required tapered insulation for total system warranty.

D. Crickets: Tapered factory pre-cut crickets, extending to roof drain sumps; types as recommended by membrane manufacturer.
   1. Crickets (tapered insulation) at roof drains shall slope 1/2 inch per 12 inches, unless otherwise indicated.

E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.9 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Fasteners: Factory-coated steel or stainless steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Adhesive for Installation of Insulation: Insulation manufacturer's recommended adhesive formulated to attach roof insulation and for attaching insulation to another insulation layer as follows:
   1. Full-spread spray-applied, low-rise, two-component urethane adhesive.

D. Cover Board: High-density, closed-cell polyisocyanurate foam core laminated to coated glass-mat, water-resistant facer; 1/2-inch thick.
   1. Thermal Value: R-2.5.
   2. Compressive Strength: ASTM D 1621, minimum 100 psi.
   3. Water Absorption: ASTM C 209, less than 3 percent volume.
   4. Products:
      a. Carlisle SynTec Incorporated; Securshield HD Cover Board Insulation.
      b. Firestone Building Products Company; Isogard HD.
         1) Cover board less than 100 psi is not acceptable.
      c. Versico Roofing Systems; Securshield HD Cover Board Insulation.

E. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.10 MISCELLANEOUS INSTALLATION MATERIALS

A. Polyurethane Foam Insulation Sealant: Minimal expansive, single- or two-component, UL classified sealant, to seal, fill, and stop air infiltration.
   1. Fire-Test-Response Characteristics: ASTM E 84, as follows:

a. Flame Spread: Not greater than 10.
b. Smoke Developed: Not greater than 20.

2. Products:
   a. Dow Chemical Company (The); Great Stuff PRO Gaps & Cracks Insulating Foam Sealant.
   b. Fomo Products Inc.; Handi-Seal Low Pressure One-Component Polyurethane Foam Sealant
   c. Owens Corning Co.; Foam Sealant for Gaps & Cracks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
   4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
   5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

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

3.2 PREPARATION

A. General: Comply with manufacturer's instructions to prepare substrate to receive EPDM 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. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
      a. At acoustical metal deck, fasteners for substrate board shall not project below deck bottom flutes.

3.5 VAPOR-RETARDER INSTALLATION

A. Install support plates for vapor retarder (barrier) furnished under Division 05 Section "Metal Fabrications."

B. Self-Adhering-Sheet Vapor Retarder (Barrier): Install vapor retarder on clean, dry deck in accordance with manufacturer's written requirements. Prime substrate if required by manufacturer. Roll out vapor retarder flat without creases; align and set in position lapping side and ends a minimum of 2 inches. Remove release film and press sheet down uniformly; all laps must be rolled down with a hand roller.
   1. On profile decking, end laps shall be laid over with an additional strip of vapor retarder or flat metal plate not less than 6 inches wide.
   2. Large gaps at angle change shall be filled with insulation to support membrane.

C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry. Protect acoustical roof deck rib insulation strips from exposure to water.

D. Install tapered insulation under area of roofing to conform to slopes indicated, or if not indicated, as required for positive drainage to roof drains.

E. Install insulation under area of roofing to achieve required thickness. Install layers, including tapered 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.

F. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

G. 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 with polyurethane foam insulation sealant.
   1. Taper insulation around roof drains, providing 4-foot square sump.
   2. Install tapered insulation and crickets to provide positive slope to drains without ponding of water.
   3. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

H. Adhered Insulation over Vapor Retarder (Barrier) for Acoustical Deck: Install first layer of insulation and adhere to vapor retarder using manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive. Adhesive shall resist specified uplift pressure at corners, perimeter, and field of roof.
   1. Adhere subsequent layer of flat or tapered insulation to proceeding layer using manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive. Adhesive shall resist specified uplift pressures at corners, perimeter, and field of roof. Comply with adhesive manufacturer's and roof system manufacturer's requirements.

I. Mechanically Fastened Insulation: Install each layer of flat and tapered 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 to resist specified uplift pressure at corners, perimeter, and field of roof, but in no case, provide less than one anchor per 4 sq. ft. of surface area (8 fasteners per 4 x 8 foot board).
   2. Screws shall be installed utilizing automatic, positive clutch disengaged and adjustable nosepiece.
   3. Install tapered edge strips at edges of tapered insulation to provide smooth transition to flat areas, free of gaps and voids.
   4. Fasten insulation and cover boards to resist uplift pressure at corners, perimeter, and field of roof.

J. Do not install more insulation in a day than can be covered with membrane before end of day or before start of inclement weather.

3.7 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions and approved Shop Drawings. Unroll membrane roofing without stretching and allow to relax before installing.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Fully Adhered Membrane: Install membrane by unrolling over prepared substrate, lapping adjoining sheets as recommended by manufacturer. Apply adhesive to surfaces to be bonded and roll into place when adhesive has properly cured. Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation.

1. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps. Position sheets to accommodate contours of roof deck to avoid bucking water.
2. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
3. Flashing details shall be done in accordance with the approved shop drawings. Base flashing shall be properly terminated and covered with counterflashing, providing not less than a 4-inch overlap.
4. Apply 6-inch wide strip of uncured EPDM to all field sheet seams, which will underlie walkway.

D. In addition to adhering, mechanically fasten roofing securely into wood blocking at terminations, penetrations, and perimeters.

E. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

F. Perimeter membrane shall extend down wall at least 1 inch past bottom of wood nailer, lapping over wall finish, but not exposed below flashing.

G. Flashing details shall be done in accordance with the approved Shop Drawings. Base flashing shall be properly terminated and covered with counterflashing, providing not less than a 4-inch overlap.

H. Adhere protection mat over roofing at kitchen exhaust fans, extending a minimum of 5 feet in all directions from units.

I. Cut out and repair membrane defects at the end of each day's work.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions and approved Shop Drawings.

B. Flashing of parapets, curbs, expansion joints, and other parts of the roof shall be performed using EPDM membrane flashing.

C. At roof edges, membrane shall run under metal roof edge flashing full length and width. Membrane shall extend down wall at least 1-inch past bottom of wood nailer, lapping over wall finish, but not exposed below flashing.

D. Flash all projections including pipes, conduits, fall arrest anchors, and curbs passing through membrane.
1. Flash pipes and conduits with pre-molded cone type flashing boots. Field-formed pipe flashing not allowed.
2. Pourable sealers not allowed.

E. Base Flashing: Tops of elastomeric base flashing shall be secured with a continuous aluminum termination bar, sealed and counterflashed.

F. All vertical flashings and membranes shall be adhered to substrates regardless of height.

G. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
   1. Keep exposed surface of EPDM free of adhesive.

H. Flash penetrations and field-formed inside and outside corners with sheet flashing conforming to manufacturer's requirements. Provide a minimum overlap of 3-inches.

I. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
   1. Keep exposed surface of EPDM free of adhesive.

J. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 WALKWAY INSTALLATION

A. Flexible Roof Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions. Install roof walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, around mechanical equipment, etc.); all locations as identified on the Drawings; and all locations required by roofing manufacturer for obtaining warranty.

3.10 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 not less than 5 business days in advance of date and time of inspection.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
   1. Coordinate staging, material placement, construction activity and pedestrian traffic protection requirements for work areas and access paths to areas where work will occur on completed roofing.

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.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

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 apply to this Section.

1.2 SUMMARY

A. This Section includes the following sheet metal flashing and trim:
   1. Manufactured roof edge trim/fascia units.
   2. Formed counterflashing and base flashing.
   3. Formed low-slope roof flashing.
   4. Formed wall flashing and trim.
   5. Formed equipment support flashing.
   6. Miscellaneous sheet metal accessories.

B. Related Sections include the following:
   1. Division 04 Section "Unit Masonry Assemblies" for installing receiver flashing in masonry.
   2. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
   3. Division 07 Section " Fluid-Applied Air/Vapor Barrier System >" for base flashing drip flashing and installing sheet metal flashing and trim tie into AVB system.
   4. Division 07 Section "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for installing sheet metal flashing and trim integral with roofing membrane.
   5. Division 07 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. SPRI Wind Design Standard for Manufactured Roof Edge Flashings: Manufacture and install roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures calculated according to **IBC 2021** and **ASCE 7-16** as follows:
   1. Reference structural drawing S00-1 for wind load design criteria.
   ~~2. Wind Speed and Exposure: 120 mph (3 second gusts), Exposure B.~~
   ~~3. Design Wind Uplift: As follows:~~
      ~~a. Roof Zone 2 - Perimeter: Positive 16 psf and negative 36 psf.~~
      ~~b. Roof Zone 3 - Corners: Positive 16 psf and negative 43.3 psf.~~

C. 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.

D. Water Infiltration: Provide sheet metal flashings and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and installation instructions.

1. Include waterproof underlayment manufacturer's written installation instructions. Variations between manufacturer's printed instructions and these Specifications shall be noted in the submittal.

C. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. 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. Include details of termination points and assemblies.
5. Include details of roof-penetration flashing.
6. Details of edge conditions, including roof edges, counter flashings and miscellaneous fabrications as applicable.
7. Details of connections to adjoining work.

D. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.

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 Certificates: For each type of roof edge flashing that is SPRI ES-1 tested.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed sheet metal flashing and trim work similar in material, design, forming method, and extent to that indicated for this Project and with a record of successful in-service performance for ten years.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual, Seventh Edition." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
   1. Copper Standard: Comply with CDA's "Copper in Architecture Handbook."

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   1. Meet with Owner, Architect, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, and roof-mounted equipment.
   2. Review methods and procedures related to sheet metal flashing and trim.
   3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
   5. Provide not less than 7 business days advance notice to participants prior to convening preinstallation conference.

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. Deliver metal coils, components, and other sheet metal roofing materials so as not to be damaged or deformed. Package shop formed sheet metal roofing materials for protection during transportation and handling.

C. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, staining, and surface damage.

D. 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. Store copper away from uncured concrete and masonry.

E. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.7 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.

1.8 WARRANTY

A. General: 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 Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer 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: Manufacturer's standard, not less than 20 years from date of Substantial Completion.

C. Special Installer's Warranty: Installer's warranty, on warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of custom-fabricated sheet metal flashing and trim that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Loose parts.
      c. Wrinkling or buckling.
      d. Failure to remain weathertight, including uncontrolled water leakage.
   2. Warranty Period: Two years for date of Substantial Completion.

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. Copper Sheet: ASTM B 370, Temper H00 or H01, cold-rolled copper sheet.

B. 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, except as modified below:
   1) Humidity Resistance: 2000 hours.
   2) Salt-Spray Resistance: 2000 hours.

b. Color: As indicated by manufacturer's designations; if not indicated, as selected by Architect from manufacturer's full range of standard options.

2. Custom flashing used adjacent and in conjunction with prepainted, aluminum sheet metal siding (07F) shall be obtained from the siding manufacturer to match siding system finish, material and thickness.

3. Custom flashing used adjacent and in conjunction with phenolic panels and high density fiber cement panels shall be .040 inch thick aluminum sheet in colors selected by Architect.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
   1. Finish: No. 2D (dull, cold rolled).

D. 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. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; 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) Colors: As indicated by manufacturer's designations in Exterior Materials Legend; if not indicated, as selected by Architect from manufacturer's full range.
   3. Custom flashing used adjacent and in conjunction with prepainted, metallic-coated steel sheet metal siding (07E) shall be obtained from the siding manufacturer to match siding system finish, material and thickness.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 30- to 40-mil- thick, slip-resisting, polyethylene-film-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release paper backing; cold applied.
   1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
   2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
   3. Products:
      a. Dri-Start "HR"; Carlisle Coatings & Waterproofing, Div. of Carlisle Co., Inc.

b. Vycor Ultra; GCP Applied Technologies (formerly W. R. Grace).

2.4 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. Nails for Tin-Zinc Alloy Coated Copper Sheet: Copper or hardware bronze, 0.109 inch minimum and not less than 7/8 inch long, barbed with large head.
2. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
3. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head, 304 stainless steel.
4. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
5. Fasteners into Preservative Treated Lumber: Stainless steel.

C. Solder for Zinc-Tin Alloy-Coated Copper: ASTM B 32, 100 percent tin.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. 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.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. 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.

I. Elastic Flashing Filler: Closed cell polyethylene or other soft closed cell material recommended by elastic flashing manufacturer as fill under flashing loops to ensure movement with minimum stress on flashing sheet.

2.5 MANUFACTURED ROOF EDGE FLASHINGS

A. Roof-Edge Fascia, Identified as Item 7H, 07J: Manufactured two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet; a continuous extruded aluminum bar with integral drip-edge to engage fascia cover and secure single-ply roof membrane; and necessary splice plates. Provide matching factory-mitered and welded corner unitsand tapered spillout type scupper unit.

1. Performance: Per IBC 2015 low-slope membrane roof system metal edge securement shall be designed and installed for wind loads and tested in accordance with ANSI/SPRI ES-1.
2. Face Height: 7 inches.
3. Fascia Cover Material: Fabricate from prefinished, sheet aluminum, not less than 0.040 inch thick.
    a. Color: As indicated in Exterior Materials Legend.
4. Accessories: Provide overflow scuppers with perforated screen. Scuppers shall be all welded construction and shall match color of roof edge fascia.
5. Basis-of-Design: Subject to compliance with requirements, provide Anchor-Tite Standard Fascia by Metal-Era, Inc. or comparable product matching indicated colors by one of the following:
    a. MM Systems Corporation.
    b. W. P. Hickman Company.

2.6 CUSTOM FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual, Seventh Edition" 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 in minimum 96-inch- lengths, but not exceeding 10-foot- long sections.

D. 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.

E. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

F. 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 (25 mm) deep, filled with elastomeric sealant concealed within joints.

G. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or other permanent separation as recommended by manufacturer/fabricator.

H. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

I. 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" for application but not less than thickness of metal being secured.

2.7 CUSTOM FABRICATED FLASHING SCHEDULE

A. Sill Flashing for Windows in Brick: Shop formed to detail; fabricated from prefinished, aluminum sheet, 0.040 inch thick minimum, color as selected by Architect; seal corners of pan type sill flashing.

B. Roof Drip Edge Strip: SMACNA Figure 4-18 C and 4-18D modified; fabricate with minimum 6 inch flange on roof and 3 inch vertical leg with continuous clip; continuous cleats, not less than 20 gage; provide backer plates at end joints; fabricate roof edge strip from prefinished, aluminum-zinc alloy-coated sheet steel, not less than 24 gage; color as selected by Architect.
   1. Performance: Roof edge fascia shall be fabricated and installed in accordance with SMACNA and the National Roofing Contractors Association's Embedded Edge for compliance with ANSI/SPRI ES-1 requirements.

C. Flashings, Drips, Window Sills and Trim: Fabricate to details and profiles indicated; hemmed exposed edges; minimum 0.040 inch thick prefinished aluminum unless indicated otherwise.
   1. Prefinished Window Sills and Louver Sills: minimum 0.050 inch thick prefinished aluminum.

D. Metal Cap Flashing for Pipe Box and Condenser Box: Fabricate to detail with continuous cleats; fabricate from copper sheet, not less than 20 ounce.

E. Drip Flashing at Base of Foundation Walls at Siding and Wall Panels: 3-inch wide metal drip flashing with hemmed edge; stainless steel sheet, minimum .019 inch (26 gage) thickness.

F. Miscellaneous Flashing at Masonry: Formed to detail; not less than 16 oz. tin-zinc alloy coated copper.

2.8 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.

B. 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 water cutoff mastic where required for waterproof performance.

C. Install sheet metal flashing and trim with minimum number of joints practical, using manufactured or shop fabricated full-length pieces. Provide one piece flashing and trim using full-length pieces without joints where run is less than the 8 to 10 foot fabricated lengths. Do not use pieces less than 24 inches long.
   1. Sill Flashing at Openings: Provide one piece flashing, full width of opening except where opening exceeds available manufactured/fabricated lengths. Provide sealed metal end dams at ends of sills. Sills flashing shall turn up on back side to form pan, directing water to the exterior.

D. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

E. 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.

F. 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.

G. 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.

H. 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.
3. Zinc-Tin Alloy-Coated Copper: Use copper or stainless steel fasteners.

I. 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 07 Section "Joint Sealants."

J. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
1. Do not solder prepainted, metallic-coated steel and aluminum sheet.
2. Pretinning is not required for zinc-tin alloy-coated copper.
3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 INSTALLATION OF MANUFACTURED ROOF FLASHINGS

A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.
1. Install manufactured roof specialties with provisions for thermal and structural movement.
2. Torch cutting of manufactured roof specialties is not permitted.

B. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

C. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

D. Fasteners: Use fasteners of type and size recommended by manufacturer but 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.

E. Seal joints with elastomeric sealant as required by manufacturer of roofing specialties.

3.4 CUSTOM FABRICATED FLASHING AND TRIM INSTALLATION

A. General: Except as otherwise indicated, install sheet metal flashing and trim comply with fabricator’s installation instructions, performance requirements, and SMACNA "Architectural Sheet Metal Manual, Seventh Edition." 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 soldered for copper, 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.

1. Fabricate in minimum 96-inch- long sections, but not exceeding 10-foot-long sections.

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 reglets or 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. Install receivers to receive counterflashing in manner and by methods indicated.
   a. Where receivers are shown in masonry, provide reglets to mason for installation as specified in Division 04 Section "Unit Masonry Assemblies."
2. 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.
3. Verify correct installation of receiver flashing with back-up plates properly set and sealed at joints for two-piece counter flashing detail.

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 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.

3.5 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.

3.6 INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Installer," has performed siding, roofing, flashing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner.**>
2. Address: <**Insert address.**>
3. Building Name/Type: <**Insert information.**>
4. Address: <**Insert address.**>
5. Area of Work: <**Insert information.**>
6. Acceptance Date: <**Insert date.**>
7. Warranty Period: <**Insert time.**>
8. Expiration Date: <**Insert date.**>

B. AND WHEREAS Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:
   1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
      a. lightning;
      b. peak gust wind speed exceeding 130 mph;
      c. fire;
      d. failure of siding and roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
      e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
      f. vapor condensation on bottom of work; and
      g. activity on work by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
   2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
   3. Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
   4. During Warranty Period, if Owner allows alteration of work by anyone other than Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Installer to perform said alterations, Warranty shall not become null and void unless Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
   5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall

become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of siding, roofing, flashing, or trim failure. Specifically, this Warranty shall not operate to relieve Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.
   1. Authorized Signature: <**Insert signature.>**
   2. Name: <**Insert name.>**
   3. Title: <**Insert title.>**

END OF SECTION 076200

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SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Exterior ~~and~~ **interior** storefront framing.
2. Exterior ~~and~~ **interior** manual-swing entrance doors.
3. ~~**Interior door frames, sidelights, and borrow lights.**~~
4. Brake metal in conjunction with frames.
5. Door hardware.
6. Sealant at interior and exterior perimeter of storefront.

B. Related Requirements:
1. Division 01 Section “Integrated Exterior Mockups” for on-site constructed mock-up requirements.
2. Division 07 Section 070800 "Building Envelope Commissioning" for Contractor's responsibilities in commissioning of building enclosure and coordination with Owner's commissioning agent.
3. Division 07 Section "Joint Sealants" for installation requirements of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
4. Division 08 Section "Glazing" for glazing and spandrel panel requirements to the extent not specified in this Section.
5. Division 26 and 27 sections for conduits, access control and intrusion low voltage wiring, mag switches door operators, and miscellaneous equipment and accessories installed in conjunction with aluminum framed entrances and storefronts.

C. Products installed, but not furnished, under this Section include the following:
1. Balance of door hardware for aluminum doors furnished in Division 08 Section "Door Hardware."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to glazed aluminum storefront and entrance systems including, but not limited to, the following:
1. Meet with Owner; Architect; Owner's commissioning agent, storefront and entrance systems Installer; storefront and entrance systems manufacturer's representative; and installers whose work interfaces with or affects storefront and entrance systems.
2. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
3. Review structural loading limitations.

4. Review coordination and tie in to air vapor barrier.
5. Review requirements for low voltage wiring concealed within storefront framing for access controls and intrusion detection systems.
6. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
7. Review required inspecting, testing, and certifying procedures.
8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.
9. Review temporary protection requirements for existing construction during and after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
11. Provide minimum advance notice of 7 business days to participants prior to convening preinstallation conference.

B. Building Envelope Commissioning: Participate in building envelope commissioning pre-construction meeting and progress meetings as required by the Contractor and the Commissioning Agent.

1.4 ACTION SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
1. Submittals for Division 08 Sections "Hollow Metal Doors and Frames," "Wood Doors," "Aluminum-Framed Entrances and Storefronts," and "Door Hardware" shall be made concurrently.

B. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include manufacturer's installation instructions for system(s) specified.
2. For sealants and sealant primers used inside the weatherproofing system, include printed statement of VOC content.

C. Shop Drawings: For aluminum-framed entrances and storefronts prepared by or under the supervision of a qualified professional structural engineer. Include plans, elevations, sections, full-size details of components, masonry openings, flashing, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.
    f. Wet glazing to retain laminated insulating glass and security glass.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

a. Provide details for hardware reinforcement for closers, overhead stops, hinges and miscellaneous auxiliary hardware.
b. Obtain templates for hardware furnished in Section 087100 and prep doors and frames for proper installation and operation.

5. Indicate fastener layout and size for transferring loads back to supporting structure.

D. Samples for Initial Selection:
1. Initial Selection of Sealant Color: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
2. Aluminum: Factory applied color finishes as selected by Architect.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts 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. Calculations shall be prepared by a professional structural engineer registered in the state where the project is located.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer signed by manufacturer certifying that Installers comply with requirements in "Quality Assurance" Article and professional engineer.

B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified independent testing agency. Tests shall be based on manufacturer's current system and shall indicate compliance with performance requirements.

D. Field quality-control reports.

E. Inspection report of egress doors.

F. Preinstallation conference meeting notes.

G. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
   1. Engineering Responsibility: Preparation of data for glazed aluminum storefront systems including the following:
      a. 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. Professional Engineer Qualifications: A professional structural engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of glazed storefront systems that are similar to those indicated for this Project in material, design, and extent.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup of typical curtain wall at location on the building as directed by the commissioning agent. ~~Comply with requirements of Section 014130 "Integrated Exterior Mockups" for on-site constructed mock-up requirements.~~
   2. Comply with requirements of Section 070800 "Building Envelope Commissioning."
   3. The Owner's commissioning agent will inspect the mockup.
   4. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.
   5. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
   6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 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, masonry opening, and wood blocking requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Failure of system to meet performance requirements.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      e. Adhesive or cohesive sealant failures.
      f. Water penetration through fixed glazing and framing areas.
      g. Failure of operating components.
      h. Glazing breakage.
   2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design aluminum-framed entrances and storefronts.
   1. Calculations shall be prepared by a professional structural engineer registered in the state where the project is located.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads..
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Deflection exceeding specified limits.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Glass breakage.
      e. Noise or vibration created by wind and thermal and structural movements.
      f. Loosening or weakening of fasteners, attachments, and other components.
      g. Failure of operating units.
      h. Sealant failure.

C. Structural Loads: Aluminum-framed entrances and storefronts shall be capable of withstanding the effects of the following loads as required by **IBC 2021** and **ASCE 7-16** as follows:
   1. Reference structural drawing S00-1 for wind load design criteria.
   ~~2. Wind Loads:~~
      ~~a. Basic Wind Speed: 120 MPH (3 Second Gust).~~
      ~~b. Exposure Category: B.~~

~~3. Wind Design Pressures:~~
~~a. Zone 4 - Field of Wall Pressures: Positive 23.4 psf and negative 25.6 psf.~~
~~b. Zone 5 - Building Corners (Within 11 Feet in Each Direction of Corner): Positive 23.4 psf and negative 29.4 psf.~~

D. Deflection of Framing Members: At design wind pressure, as follows:
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.
   a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
   a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

E. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
   a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
2. Entrance Doors:
   a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

H. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.69 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.20 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 62 as determined according to NFRC 500.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 0 deg F.
    c. Interior Ambient-Air Temperature: 75 deg F.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:
1. Kawneer North America:
    a. Exterior Storefront and Entrances: Trifab 451T frames with 500 Heavy Wall Entrances with glazing stops from 500 IR Heavy Wall Entrances.
    ~~**b. Interior Storefront and Entrances (Vestibules): Trifab VG 451 frames with 500 Heavy Wall Entrances with glazing stops from 500 IR Heavy Wall Entrances.**~~
    ~~**c. Interior Storefront and Entrances: Trifab 451 frames with 500 Heavy Wall Entrances.**~~
2. Oldcastle Building Envelope:
    a. Exterior Storefront and Entrances: Series 3000 Thermal MultiPlane Storefront System with Rugged WS (Wide Stile) Entrances with glazing stops from WSD-500 StormMax Entrance Doors.
    ~~**b. Interior Storefront and Entrances (Vestibules): Series 3000 with Series 500 Rugged WS (Wide Stile) Entrances with glazing stops from WSD-500 StormMax Entrance Doors.**~~
    ~~**c. Interior Storefront and Entrances: Series 3000 with Series 500 Rugged WS (Wide Stile) Entrances.**~~
3. Tubelite:
    a. Exterior Storefront and Entrances: T14000 I/O Series Multiplane frames with Monumental Wide Stile Entrances with glazing stops from ForceFront Storm Monumental Wide Stile Doors.
    ~~**b. Interior Storefront and Entrances (Vestibules): E14000 frames with Monumental Wide Stile Entrances with glazing stops from ForceFront Storm Monumental Wide Stile Doors.**~~
    ~~**c. Interior Storefront and Entrances: E14000 frames with Monumental Wide Stile Entrances.**~~

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing, entrance doors, and accessories, from single manufacturer.
1. Aluminum-framed entrances and storefront systems specified in this Section and curtain wall system specified in Division 08 Section "Glazed Aluminum Curtain Wall" shall be from same manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: As follows:

a. Exterior Framing Members: Composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance.
   1) Where required by wind loads, provide heavy wall members or internal reinforcement.

~~**b. Interior Framing Members: Nonthermal.**~~

2. Glazing System: As follows:
   a. For Storefront and Entrances Indicated to Receive LAM, LAM-IG or SG Glazing: Retained mechanically with gaskets on unprotected side (exterior side) and wet glazed with structural silicone sealant on protected side (interior side).
      1) Structural silicone sealant required to retain the laminated glass, security glass and laminated IG units in place during forced entry attack.
   b. For Storefront Transoms Indicated to Receive IG Glass or Tempered Glass: Retained mechanically with gaskets on four sides.
3. Glazing Plane: ~~**Center**~~ Front.
4. Finish: High-performance organic finish for storefront and entrances used in exterior walls.
5. Fabrication Method: Screw spline system.
6. Provide components having face width indicated on Drawings.
7. Provide thermally broken extruded aluminum subframes for storefront sills.
8. Provide thermally broken extruded aluminum sill flashing with end dams for exterior storefronts.
9. Provide operable door units manufactured by storefront system manufacturer.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
1. Provide extra-heavy reinforcement for hinges and closers for doors and frames.
2. Provide extra-heavy reinforcement for doors and frames receiving concealed overhead stops. Specified stop manufacturer’s installation indicates doors and frames be properly reinforced with 3/16-inch minimum thickness plate.

D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   a. Sheet and Plate: ASTM B 209.
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
   a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual- and power-assisted-swing operation.
   1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   2. Door Design: Wide stile; 5-inch nominal width with 10-inch high bottom rail, and 6-inch cross rail.
   3. Glazing Stops and Gaskets: As follows:
      a. Provide nonremovable glazing stops on outside of exterior doors ~~**and to nonsecured side of interior doors**~~.
      b. Glazing Stops for Exterior Doors ~~**and Interior Vestibule Doors**~~: Stops shall be stops from hurricane-resistant door assemblies; finished to match frame.
         1) Stops shall provide a minimum 1/2-inch bite on the security glass (SG) and insulated laminated glass (LAM-IG) to retain the glass during forced entry attack.
         2) Glazing to be wet glazed with structural silicone sealant on protected side (interior side) as specified in Division 08 Section "Glazing" to retain the glass during forced entry attack.
      ~~**c. Glazing Stops for Interior Doors, Sidelites and Borrowlites: Manufacturer's standard height stops.**~~
         ~~**1) Glazing to be wet glazed with structural silicone sealant on protected side (interior side) as specified in Division 08 Section "Glazing" to retain the glass during forced entry attack.**~~
   4. Reinforcing: Provide supplemental reinforcing plates for door hardware attachment, including hinges, closers and overhead stops.

2.5 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes, numbers, and types recommended by entrance system and hardware manufacturers 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 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
      ~~**b. Accessible Interior Doors: Not more than 5 lbf to fully open door.**~~

B. Continuous, Gear-Type Hinges: Heavy-duty, extruded aluminum, pinless, concealed geared hinge leaves; joined by a continuous extruded aluminum channel cap; with concealed, self-lubricating with stainless-steel bearings between knuckles; fabricated one piece without splices full height of door and frame. Finish to match doors. Provide continuous hinges for ~~**interior and**~~ exterior aluminum doors.
   1. Manufacturer: Select Hinges. No substitution.
      a. Coordinate EPT product being supplied and template cutout requirements with Section 087100 hardware supplier

C. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC. Provide at head and jamb of all exterior doors for weather control.

D. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

E. Silencers: BHMA A156.16, Grade 1.

F. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch, thermally broken. Coordinate cutouts for operating hardware with anchors and jamb clips. Provide 1/4 inch high
1. Material: Aluminum, mill finish.
2. Provide 1/4 inch high thresholds at door openings C101D, C101E, C101F.
3. Provide half saddle threshold to butt tight to entrance mat frames or tile at door openings A101, A101A, A101B, B132, A101C, B132, B132A, C108B, C108C, D139.

G. Balance of Hardware: Furnished in Division 08 Section "Door Hardware" for installation with the aluminum door and frame installation.

2.6 GLAZING

A. Glazing: Specified in Section 088000 "Glazing."

B. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
1. Color: As selected by Architect.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members to receive fastener threads.
3. Do not use exposed fasteners, except for hardware application. For hardware application, use exposed fasteners with countersunk Phillips screw heads, stainless steel, finished to match framing system or hardware being fastened, unless otherwise noted.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

E. Aluminum Brake Metal: Form exposed flashing from sheet aluminum ~~**finished to match framing**~~ and of sufficient thickness, not less than 0.063-inch thick, to maintain a flat appearance without visible deflection.

1. Finish: High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Color and Gloss: Kawneer Permadized Hardcoat Finish, color selection by Architect from manufacturers full range of standard colors.

F. Insulation Foam Sealant: On-site foam-in-place, single polyurethane component foam insulation sealant; Class 1 foam.

1. Products:
   a. GREAT STUFF PRO Gaps & Cracks Insulating Foam Sealant; Dow Chemical Company (The).
   b. Insulating Foam Sealant Gaps & Cracks; Owens Corning Foam Insulation, LLC.

2.8 FABRICATION

A. General: Fabricate glazed aluminum storefront and entrances systems assemblies according to approved 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. Form or extrude aluminum shapes before finishing.

C. 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. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge 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.

E. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

1. Glazing for exterior and vestibule storefront assemblies and entrances, except transoms, shall be wet seal glazed with silicone structural glazing sealant on the protected side (interior side) to retain glass during physical attack.

~~**2. Glazing for interior storefront sidelights and borrow lights receiving laminated glass (LAM) and receiving butt glazing shall be wet seal glazed with silicone structural glazing sealant on the protected side (interior side) to retain glass during physical attack.**~~

3. Glazing for storefront assemblies in exterior transoms and vestibule transoms and other storefront locations shall be standard glazing.

F. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

G. Storefront Framing: Fabricate components for assembly using screw-spline system.

H. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door 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 three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.**~~

I. Entrance Doors: Reinforce doors as required to support loads imposed by door operation and for installing entrance door hardware.
1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.
3. Glazing stops for doors shall be stops from hurricane-resistant door assemblies.
4. Protected side (interior side) of glazing shall be wet seal glazed with silicone structural glazing sealant.

J. Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
1. Install hardware for aluminum entrances furnished in Division 08 Section "Door Hardware."

K. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

~~**A. Clear Anodic Finish, Interior Storefront: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.**~~

B. High-Performance Organic Finish, Exterior Storefront: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: Kawneer Permadized Hardcoat Finish, color selection by Architect from manufacturers full range of standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Confirm that wood blocking, where used, has been sufficiently fastened to transfer storefront wind loads back to structure.

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

3.2 PREPARATION

A. Prior to setting storefront, seal gaps between the ends of the brick returns and wood blocking and between back of lintel angles and wood blocking with foam sealant to seal joint, preventing cold air from entering that will short circuit the thermal break in aluminum storefront.

3.3 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 nonmovement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

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 07 Section "Joint Sealants" to produce weathertight installation. Install sills in one piece, full width of opening except where opening exceeds 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.

F. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

G. Install glazing as specified in Division 08 Section "Glazing."

1. At storefront frames and doors, mask frame and glass to provide smooth, uniform tooling of structural sealant, with straight edges.

H. Install weatherseal sealant according to installation requirements in Division 07 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer. Color of sealant to match Architect selection. Provide sealants around storefront perimeter on interior sides between frame and air/vapor barrier and exterior sides between frame and exterior finishes.

I. Entrance Doors: Install doors and windows to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
   3. Install door hardware furnished in Division 08 Section "Door Hardware," including continuous hinges, power assist door operators, closers, pulls, exit devices, removable mullions, electric strikes, magnetic switches, overhead stops, trims and miscellaneous hardware as scheduled.
   4. Coordinate with access control and intrusion contractor and electrical contractor to provide access for conduits, concealed low voltage wiring within entrance and storefront frames for door operators, electrified mag switches and miscellaneous equipment and accessories installed in conjunction with aluminum framed entrances and storefronts.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts 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 more, 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.

3.5 FIELD QUALITY CONTROL

A. Commissioning Agent: The Owner has hired a commissioning agent to perform tests and inspections, and to prepare test reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections and tests.
   1. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
   2. Commissioning agent shall prepare test and inspection reports.
   3. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

4. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

B. Aluminum-framed entrances, storefronts and windows will be considered defective if they do not pass tests and inspections.

C. Commissioning agent shall prepare test and inspection reports.

D. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

F. Egress Door Inspections:
   1. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
   2. Inspect each door equipped with panic hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
      a. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
      b. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
      c. Inspection agency shall prepare inspection reports.

END OF SECTION 084113

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SECTION 108500 - BUILDING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Knox box.
   2. Corner guards.

1.3 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

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 not included in product data for each product specified. Shop Drawings shall indicate materials, gauges, dimensions and method of attachment.

D. Samples: For each product involving a color selection, submit the manufacturer's color charts showing the full range of colors and patterns available.

E. Maintenance Data: For all items to include in Operating and Maintenance Manuals specified in Division 01 Section "Operation and Maintenance Data."
   1. Include maintenance date for projection screens.

F. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide corner guards 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:
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver video curtains and tracks until spaces to receive them are clean, dry, and ready for installation of video curtains and tracks.

1.7 WARRANTY

A. Corner Guard Special Warranty: Written warranty, signed by manufacturer agreeing to replace corner guard systems that do not comply with requirements or that have material or manufacturing defects within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 CORNER GUARDS

A. Stainless Steel Corner Guards: Surface mounted, one-piece with formed edges; stainless steel, Type 304 with satin finish; not less than 0.0625 inch; 3-1/2 by 3-1/2 inches. Mount with flat-head, countersunk screws through factory-drilled mounting holes.
   1. Location: Where indicated.

B. Stainless steel corner guards specified in Division 11 Section - Foodservice Equipment for Commercial Kitchen.

2.3 KNOX BOX

A. Knox Box: Flush mount with masonry anchorage kit, finish to be selected by Architect. Coordinate order placement with Fire Department authorization. Coordinate mounting height and location in field with Architect.
   1. Provide flushed mounted box with recess mounting kit. .
   2. Finish: As selected by Architect.
   3. Quantity: Four.

4. Product: Knox Company; Knox Box, Series 4400.
   a. Provide Series 3200 at one location.

2.4 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.

E. Molds, trim, frames and other metalwork shall be proper dimensions to receive masonry block and tile, plaster, ceramic tile, etc.

PART 3 - EXECUTION

3.1 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. Examine roughing-in for electrical systems to verify actual locations of electrical connections before installation of projection screens, scoreboards and shot clocks.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. All items specified under this Section shall be installed in strict accordance with manufacturer's recommendations and approved Shop Drawings.

3.3 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 221616 - FACILITY LIQUEFIED-PETROLEUM GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.

B. The one above grade propane tank, preparation, interconnected piping, pressure regulators, valves, gauges, interconnected underground piping, underground piping from the tank up to and including the building regulator shall be installed by a company the owner negotiates a fuel contract with.

C. For bidding purposes Dead River Company shall be contacted to provide pricing. The installation for the tank and pipe trenching/backfilling shall be provided by Divison 31-33.
   1. Contact: David Luce.
   2. Address: Dead River Company, 82 Running Hill Road, Suite 400, South Portland, ME 04106.
   3. Telephone:
      a. Office: (207) 358-5787
      b. Mobile: (207) 712-6141
      c. Toll Free: (800) 287-5841
   4. Email: david.luce@deadriver.com

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. LPG: Liquefied-petroleum gas.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. For Piping Containing Only Vapor:
      a. Piping and Valves: 125 psig (862 kPa unless otherwise indicated).

B. LPG System Pressure between tank and Building: Maximum pressure of 5 PSI shall be delivered from tank to building.

C. LPG System Pressure within Buildings: One pressure range; 11 inches water column

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Corrugated stainless-steel tubing with associated components.
   3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   4. Pressure regulators
   5. Dielectric fittings.
   6. Escutcheons.

B. Delegated-Design Submittal: For LPG 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.
   1. Detail fabrication and assembly of seismic restraints.
   2. Design Calculations: Calculate requirements for selecting seismic restraints.
   3. Underground L.P. pipe sizing from the tanks to the building ~~**and the emergency generator**~~ by the gas supplier.

C. Coordination Drawings: Plans and details, drawn to scale, on which LPG piping is shown and coordinated with other installations, using input from installers of the items involved.

D. Site Survey: Plans, drawn to scale, on which LPG piping is shown and coordinated with other services and utilities.

E. Qualification Data: For qualified professional engineer.

F. Welding certificates.

G. Field quality-control reports.

H. Operation and Maintenance Data: For LPG equipment and accessories to include in emergency, operation, and maintenance manuals.

I. Fire Safety Analysis Report for LP-Gas Storage Facilities: Provide and file a Fire Safety Analysis report to the State of Maine before proceeding with the installation of underground storage tanks. The Fire Analysis Report is required when the aggregate capacity of LP-storage is greater than 4,000 gallons.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing LPG piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store pipes and tubes with protective PE coating to avoid damaging coating and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Provide one above grade 1,000 gallon above ground tank and associated accessories.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedules 40 and 80, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.

3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. 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.
    a. 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.
        1) Flame-Spread Index: 25 or less.
        2) Smoke-Developed Index: 50or 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 (34.5 kPa).

C. 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.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    b. Outlet shall be threaded or flanged or suitable for welded connection.

c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings, NPS 1-1/2 (DN 40) and Smaller: Capable of joining PE pipe to PE pipe.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Lyall, R. W. & Company, Inc.
      2) Mueller Co.; Gas Products Div.
      3) Perfection Corporation; a subsidiary of American Meter Company.
   b. PE body with molded-in, stainless-steel support ring.
   c. Buna-nitrile seals.
   d. Acetal collets.
   e. Electro-zinc-plated steel stiffener.

2.2 PIPING SPECIALTIES

A. Flexible Piping Joints:
1. Approved for LPG service.
2. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
3. Minimum working pressure of 250 psig (1723 kPa) and 250 deg F (121 deg C) operating temperature.
4. Flanged- or threaded-end connections to match equipment connected and shall be capable of minimum 3/4-inch (20-mm) misalignment.
5. Maximum 36-inch (914-mm) length for liquid LPG lines.

B. 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. Corrugated stainless-steel tubing with polymer coating.
4. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
5. End Fittings: Zinc-coated steel.
6. Threaded Ends: Comply with ASME B1.20.1.
7. Maximum Length: 72 inches (1830 mm).

C. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

D. 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 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig (862 kPa).

E. 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.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for LPG.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller for Vapor Service: Comply with ASME B16.33.
1. CWP Rating: 125 psig (862 kPa).
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inch (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
1. CWP Rating: 25 psig (862 kPa)
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Watts
   c. Conbraco Industries, Inc.; Apollo Div.

d. Lyall, R. W. & Company, Inc.
e. McDonald, A. Y. Mfg. Co.
f. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4143 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for LPG service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for LPG.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, Itron Model, B34 or comparable product by one of the following:
a. American Meter Company.
b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
c. Invensys.
d. Maxitrol Company.
3. Body and Diaphragm Case: Cast iron or die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
7. Orifice: Aluminum; interchangeable.
8. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
9. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet and no pressure sensing piping external to the regulator.
10. Pressure regulator shall maintain discharge pressure setting downstream and not exceed 150 percent of design discharge pressure at shutoff.
11. Overpressure Protection Device: Factory mounted on pressure regulator.
12. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
13. Maximum Inlet Pressure: 5 psig.
14. Set regulator to deliver 12” water column.

15. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
16. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
17. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
18. ~~**ALTERNATE #5: Provide regulator set to deliver the required operating pressure for the emergency generator.**~~

2.6 DIELECTRIC FITTINGS

A. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for LPG.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.7 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.8 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. Calpico Inc.
   c. Metraflex Company (The).
   d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.9 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Escutcheons: With set screw.
   1. Finish: Polished chrome-plated.

2.10 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 (150 mm) wide and 4 mils (0.1 mm) 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 (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for LPG 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 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 PREPARATION

A. Close equipment shutoff valves before turning off LPG to premises or piping section.

B. Inspect LPG piping according to NFPA 58 and the International Fuel Gas Code to determine that LPG utilization devices are turned off in piping section affected.

C. Comply with NFPA 58 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.4 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 58 and the International Fuel Gas Code requirements for installation and purging of LPG piping.

B. Install underground, LPG piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
   1. If LPG piping is installed less than 36 inches (914 mm) below finished grade, install it in containment conduit.

C. Install underground, PE, LPG piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
   3. Replace pipe having damaged PE coating with new pipe. CSA B149.1 requires protective coating for Type G and Type L (Type B) copper pipe and tube installed underground.

E. Install fittings for changes in direction and branch connections.

F. Joints for connection to inlets and outlets on vaporizers, air mixers, regulators, and valves may be flanged or threaded to match the equipment.

G. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

H. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."

3.5 INDOOR PIPING INSTALLATION

A. Comply with NFPA 58 and the International Fuel Gas Code for installation and purging of LPG piping.

B. 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, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install LPG piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons for penetrations of interior walls, ceilings, and floors.
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      c. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

L. 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 in Division 07 Section "Penetration Firestopping" for materials.

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

R. Concealed Location Installations: Except as specified below, install concealed LPG piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
   1. Above Accessible Ceilings: LPG piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
   2. In Floors: Install LPG corrugated stainless steel piping with PE covering suitable for direct bury with integral vented jacket and vent relief fittings. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    a. Exception: Tubing passing through partitions or walls does not require striker barriers.
4. Prohibited Locations:
    a. Do not install LPG piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install LPG piping in solid walls or partitions.

S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

T. Connect branch piping from top or side of horizontal piping.

U. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

V. Do not use LPG piping as grounding electrode.

W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

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 ID 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.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (16 mm).

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install LPG piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1830 mm) of each gas-fired appliances and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (305 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior LPG piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, 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 semigloss.
      d. Color: To Match the Building exterior color.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Test, inspect, and purge LPG according to NFPA 58 and the International Fuel Gas Code and requirements of authorities having jurisdiction.

C. LPG piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain LPG equipment.

3.14 OUTDOOR PIPING SCHEDULE

A. Retain and revise applicable piping applications. Coordinate with materials specified in Part 2. Retain multiple materials for Contractor's option.
   1. Retain "one of" option in first paragraph below to allow Contractor to select piping materials from those retained.

B. Underground LPG vapor piping shall be the following:
   1. PE pipe and fittings joined by heat-fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

C. Aboveground LPG vapor piping shall be one of the following:
   1. Schedule 40, steel pipe with malleable-iron fittings and threaded or pressed joints.
   2. Schedule 40, steel pipe with wrought-steel fittings and welded joints, or mechanical couplings.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be one of the following:
   1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
   2. Schedule 40, steel pipe with malleable-iron fittings and threaded or pressed joints.

B. Aboveground, distribution piping shall be one of the following:
   1. Schedule 40, steel pipe with malleable-iron fittings and threaded or pressed joints.
   2. Schedule 40, steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be the following:
   1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.

D. Distribution piping valves for pipe NPS 2 (DN 50) and smaller shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

E. Distribution piping valves for pipe NPS 2-1/2 (DN 65) and larger shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

F. Valves in branch piping for single appliance shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 221616

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SECTION 230900 – INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Direct Digital Control (DDC) equipment.

B. Software.

C. Installation.

D. Mechanical Commissioning.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Piping:
1. Control Valves – piping connections.
2. Temperature Sensor Wells and Sockets.
3. Pressure Sensors and Switches.
4. Flow Switches.

B. Ductwork:
1. Access Doors.
2. Airflow Measuring Stations.
3. Dampers - ductwork connections.

1.3 PRODUCTS FURNISHED UNDER OTHER SECTIONS

A. Controllers furnished with some Plumbing equipment (Division 22).

B. Controllers furnished with some HVAC equipment (Division 23).

C. Monitoring devices furnished with some Electrical equipment (Division 26).

1.4 RELATED SECTIONS

A. Division 08 Section “Access Doors and Frames.”

B. Division 23 Section “Common Work Results for HVAC.”

C. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

1.5 REFERENCES

A. U.S. Department of Justice – 2010 ADA Standards for Accessible Design.

B. ASME MC85.1 - Terminology for Automatic Control.

C. NEMA EMC1 - Energy Management Systems Definitions.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA 70 - National Electrical Code.

F. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

1.6 SYSTEM DESCRIPTION

A. A fully integrated Automatic Temperature Control (ATC) Building Management and Control System incorporating Direct Digital Control (DDC), energy management, equipment monitoring, and control consisting of the following:
   1. Microcomputer-based equipment controllers interfacing directly with sensors, actuators and environmental delivery systems.
   2. Electric controls and mechanical devices for items indicated on Drawings and described hereinafter including dampers, valves, and motor drives.
   3. Microcomputer-based terminal controllers interfacing with sensors, actuators, and terminal equipment control devices.

B. Submittals, data entry, electrical installation, programming, start up, test and validation, instruction of Owner's representative on maintenance and operation, as built documentation, and system warranty.

C. System Summary:
   1. The intent of this project is to provide an ATC system with electric actuators
   2. Items which according to the Sequence of Operations are designated to be controlled by a thermostat, such as Cabinet unit heaters, unit heaters, terminal heating units, and the like, shall have “stand-alone” control, and are not required to be interfaced with the DDC system. At the Contractor’s option, they may have DDC control, but with local setpoint control.
   3. Equipment which is designated to be controlled by a temperature sensor shall be interfaced with the DDC system, such that monitoring and setpoint adjustment shall be accomplished through the graphical user interface at the operator workstation.

D. Note: The terms “BMS”, “ATC”, and “DDC” are used somewhat interchangeably throughout this Section.

1.7 DEFINITIONS

A. Note: The terms ATC, BAS, and DDC may be used interchangeably in this Section and on the Drawings, to indicate the overall control system.

B. Definitions:
   1. ATC: Automatic temperature control.
   2. BACnet: A control network technology platform for designing and implementing interoperable control devices and networks.
   3. BAS: Building Automation System.
   4. DDC: Direct digital control.
   5. I/O: Input/output.
   6. MS/TP: Master slave/token passing.
   7. PC: Personal computer.
   8. PID: Proportional plus integral plus derivative.

9. RTD: Resistance temperature detector.

1.8 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
   2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
   3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
   4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
   5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds.
   6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
   7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
   8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
      a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
      b. Water Flow: Plus or minus 5 percent of full scale.
      c. Water Pressure: Plus or minus 2 percent of full scale.
      d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
      e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
      f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
      g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
      h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
      i. Relative Humidity: Plus or minus 5 percent.
      j. Electrical: Plus or minus 5 percent of reading.

1.9 SUBMITTALS

A. Submit in accordance with Division 01 Section “Submittal Procedures.”

B. Qualification Data: For Installer and manufacturer.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
   2. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Bill of materials of equipment indicating quantity, manufacturer, and model number.

2. Schematic flow diagrams showing fans, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including size and flow characteristics.
8. DDC System Hardware:
    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control units.
9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.

E. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or CD, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

F. Field quality-control test reports.

G. Operation and Maintenance Data.

1.10 OPERATION AND MAINTENANCE DATA

A. For mechanical instrumentation and control system to include in emergency, operation, and maintenance manuals.

B. In addition to items specified include the following:
1. Maintenance instructions and lists of spare parts for each type of control device.
2. Exploded assembly views.
3. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

C. Manuals: Provide the following:
1. An Operator's Manual with graphic explanations of keyboard use for operator functions specified under Operator Training.
2. Computerized printouts of equipment controller’s data file construction including point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, and others as applicable.
3. A manual including revised as-built documents of materials required under the paragraph

"SUBMITTALS" in this Specification Section.

4. Provide the quantity of manuals specified and at least 2 Operator's Manuals and 2 As-Built Manuals to the Owner. Refer to other Sections of the Specifications for project requirements for quantities of documentation.

1.11 CODES AND APPROVALS

A. The complete temperature control installation shall be in strict accordance to the national and local electrical codes and the electrical Division of these Specifications. Devices designed for or used in line voltage applications shall be UL listed. Microprocessor based remote and central devices shall be UL916 Listed.

B. Electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.

1.12 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE Standard 135 (BACnet) for DDC system components.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions.

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, provide shipping of control devices to equipment manufacturer, in a timely manner coordinated with the equipment manufacturer.

C. Components to be Installed under Other Sections: For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

1.14 COORDINATION

A. Coordinate location of thermostats and other exposed control sensors with Contract Drawings before installation.

B. Coordinate equipment with Division 26 and existing fire alarm system to achieve compatibility with equipment that interfaces with that system.

C. Coordinate line-voltage power supplies with Division 26.

1.15 WARRANTY

A. Components, system software, parts, and assemblies furnished under this Section shall be

guaranteed against defects in materials and workmanship for 1 year from acceptance date.

B. Labor to troubleshoot, repair, reprogram, or replace system components shall be provided at no charge to the Owner during the warranty period.

C. Corrective software modifications made during warranty service periods shall be updated on user documentation and on user and manufacturer archived software disks.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS

A. Acceptable Manufacturers and Installers:
1. Maine Controls, 400 Presumpscot Street, Portland, ME 04103.
2. Trident Controls Inc., 187 Gray Road, Unit A, Cumberland, ME 04021.
3. ibcontrols, 3 Pope Rd, Windham, ME, 04062
4. Siemens Building Technologies, Inc., 66 Mussey Road, Scarborough, ME 04074.
5. Honeywell Controls, installed by Honeywell Inc., 68 Darin Drive, Augusta, ME 04330.
6. **Basix Automation with Schneider Controls**
7. Siemens Building Technologies, Inc., 11 Court St., Exeter, NH 03833.
8. Control Technologies, New Hampshire Office, 111 Zachary Road, Manchester, NH 03109.
9. Control Technologies, Massachusetts Office, 500 West Cummings Park, Suite 1050, Woburn, MA 01801.
10. Control Technologies, New York Office, 3500 Sunrise Highway, Suite T209, Great River, NY 11739.
11. Control Technologies, Vermont Office, 121 Park Avenue, Suite 10, Williston, VT 05495.
12. Johnson Controls Inc., 915 Holt Ave, Manchester, NH 03109.
13. Johnson Controls Inc., 30 Thomas Drive, Westbrook, ME 04092.
14. Substitutions: Not permitted.

B. The Temperature Control Contractor (or Subcontractor) shall hereinafter be referred to as the ATC Contractor.

2.2 SYSTEM REQUIREMENT

A. Provide complete direct digital and electronic control system consisting of temperature sensors, thermostats, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified. Provide controls for the following:
1. Air conditioning systems.
2. Air moving and handling systems.
3. Boilersand fuel-fired equipment.
4. Control dampers and valves.
5. Cooling and heating coils.
6. Cooling and heating terminal units.
7. Exhaust, return, and supply fans.
8. Filter pressure drops.
9. Heat recovery systems.

10. Kitchen ventilation systems.
11. Outside air and ventilation.
12. Radiant floor heating.
13. Temperature and humidity monitoring.
14. Hot water heating systems.
15. Fire alarm system interfaces.
16. Graphical workstation.
17. Variable frequency drives for pumps and fans.
18. Provide hardware and software required for remote monitoring of the ATC system through modem or ethernet interface.

2.3 DATA INPUTS AND OUTPUTS

A. Input/output sensors and devices shall be closely matched to the requirements of the remote panel for accurate, responsive, noise-free signal input/output. Control input response shall be high-sensitivity and matched to the loop gain requirements for precise and responsive control.

B. Duct temperature sensors shall be rigid stem or averaging type as required. Provide water sensors with a separable copper, monel or stainless-steel well.

C. Control relays and analog output transducers shall be compatible with equipment controllers output signals. Relays shall be suitable for the loads encountered. Analog output transducers shall be designed for precision closed loop control with pneumatic repeatability error no greater than 1/2 percent.

D. Data inputs and outputs shall be compatible with variable frequency drives; see Division 23 Section “Common Motor Requirements for HVAC Equipment.”

2.4 TEMPERATURE CONTROL CENTRAL HARDWARE

A. Equipment controllers shall be 16 bit microprocessor based with EPROM operating system (O.S.). ATC programs and data files shall be non-volatile EEPROM or flash memory to allow simple additions and changes. Each equipment controller shall have an on-board real-time clock with battery backup of a minimum of 30 days.
   1. Equipment controllers shall be provided where indicated or specified with capacity to accommodate input/output (I/O) points required for the application plus spare points specified. These panels shall be configured with analog and digital inputs and outputs, and pulse counting totalizers and such that the primary input, the output and control logic shall be resident in a single microprocessor to provide network independent stand-alone closed loop ATC.
   2. Panel electronics shall be installed in suitable enclosures. Equipment room panels shall have hinged doors and shall also contain the load relays, transducers, and associated equipment.

B. Terminal Equipment Controllers shall be EEPROM based and modularity expandable to accommodate additional points if required for future functional changes or enhancements, and with I/O selected for the application plus specified spares. Terminal controllers shall be capable of processing sensor signals of the applications specified, and shall have capability to drive digital (on-off), pulse width modulation, and true analog (0-10V) outputs. Terminal Controller enclosures shall be compact, finished steel to fit within or on terminal equipment. Each terminal controller shall have complete standalone capability.

2.5 OPERATOR STATION SOFTWARE

A. Operator Station (OS) software shall include as a minimum the Operating System, Data Base Manager, Communications Control, Operator Interface , Trend and History Files, Report Generator, and Support Utilities.
   1. Real time operating system shall be true multi-tasking providing concurrent execution of multiple real time programs and custom program development.
   2. Data Base manager is to manage data on an integrated and non-redundant basis. It shall allow additions and deletions to the data base without any detriment to the existing data.

B. Operator Interface Software:
   1. Operator access to the system is to be under personal ID and password control for up to 100 unique operators.
   2. Up to 100 frequently addressed system points shall be definable as "quick access" points. Each points user address, descriptor, and value/status shall be displayed.
   3. Software capacity and user's license shall be unlimited in the quantity of points and tags it can accommodate. Owner shall be able to add points and tags without purchasing additional software or licensing.
   4. Points (physical and pseudo) shall be displayed with dynamic data provided by the system with appropriate text descriptors, status or value, and engineering unit. Points shall be dynamic and shall continuously update anytime their field status/value changes.
   5. An on-line context-sensitive help utility shall be provided to facilitate operator training and understanding.
   6. Electronic messaging facility shall be provided on the operator station for any operator to enter a message to another operator.

C. Site Specific Customizing Software:
   1. Provide software which will allow the user to modify and tailor the temperature control to the specific and unique requirements of the equipment installed, the programs implemented, and to staffing and operational practices.
   2. Point alarms shall be user-classifiable as critical or non-critical. Critical alarms shall be displayed in a dialog box of the color monitor. Display shall include time and date of occurrence, indication of alarm condition, analog value or status, user address, and alarm message.
   3. A discrete per point detailed alarm-action taking message of up to 480 characters shall be available for each point.
   4. Alarms shall be directed to the user selected alarm printer.
   5. Non-critical alarms shall only output to the printer and OS disk in order of occurrence.
   6. Run time limit messages shall be presented and processed as alarm messages except the action message shall be of a maintenance directive nature.

D. Dynamic trends shall provide for each OS of up to eight user selected points to show real time activity of the associated points. This information shall be printed and/or displayed in numeric, bar chart, curve plot, pie chart, and other formats, as selected by the operator.

E. Standard Reports Shall Be Provided Which Shall Be Output onto the Selected Report Printer. The Following Standard Pre-formatted Reports Shall Be Provided:
   1. The user shall be provided with a command trace feature selectable on a per point basis allowing the archiving of commands issued to each point.
   2. A custom report capability shall be provided to allow the user to format reports of any mix of text, points with status/value and descriptors, and points with status/value only.

3. Alarm history. The last 4000 alarm events shall be disk archived. Viewing or printing shall be by entering a date range (from-to).
4. Operator activity. Operator activity shall be archived. Viewing or printing shall be by entering a desired date range.
5. Trend reports shall allow the operator to randomly select point archival. Equipment controllers trend points (hardware and software) shall be assignable to PC archive files for display at user selectable intervals of 10 seconds to 24 hours.

F. Equipment controllers shall be up-line or down-line loadable to or from the OS disk for backup archival.

G. Provide software to execute and observe diagnostics of any remote device connected to the peer bus and the ability to deactivate and restart the device.

H. In addition, a word processing utility, graphics package, and spreadsheet shall be available for generic use. The base system software shall include a CRT "windowing" feature to allow the operator to monitor the real time system and use third party software simultaneously.

2.6 GRAPHIC PROGRAMMING

A. Graphic Programming. Provide hardware and software required for complete equipment controllers ATC programming of plant programs including plant system schematic development, I/O hardware point definition, hardware and software text point descriptors, ATC algorithmic development, a controller software loading utility, and a live programming test facility. At a minimum, the following shall be provided in the graphics package:
1. Boilers - control and status.
2. Heating water pump - control and status.
3. Fuel oil transfer pump set - status
4. Heat recovery pump - control and status
5. Exhaust fans EF-4,5,7 and 14 - control and status
6. Floor plans showing temperature sensors - control and status.
7. Air handling units, rooftop HVAC units and associated pumps, fans, dampers - control and status.

B. Provide a Boolean logic switching table matrix module for building ON-OFF commands from combinations of and or functions.

C. Provide a program testing utility which allows live and dynamic monitoring of the graphically displayed control programs provided.

D. In addition to training specified elsewhere in this Specification, provide 4 days of additional programming training, at a minimum of 4 hours training per day. These 4 days of additional training shall be provided during the 1 year warranty period. They are intended for use by the Owner as questions regarding system operation arise. Coordinate with the Owner.

E. Provide 2 sets of programmer’s manuals.

2.7 CONTROLLER SOFTWARE

A. Energy Management application programs and associated data files shall be in non-volatile

memory.

1. Optimum Start shall delay equipment start-up based on global outdoor temperature, space temperature, and system response to assure that comfort conditions are reached at scheduled occupancy. The optimum start program shall operate fully stand-alone in the local equipment controllers.
2. A load reset program shall be provided to assure that only the minimum amount of heating, cooling, and electrical energy is supplied to satisfy zone temperature requirements.

B. Control Software:

1. Each equipment controllers shall contain up to 20 unique user modifiable time programs.
2. Control Application Software shall be customized strictly to meet the detailed requirements of the "Sequence of Operation" specified hereinafter. Equipment controllers and terminal controllers shall be fully programmable. Initial software shall be fully modifiable, and not restricted by vendor's specific configuration guidelines. Equipment controllers control software shall be designed via a graphic programming facility, the detailed graphic design of which shall be provided as system documentation. Control strategies shall be advanced as noted with stabilizing setpoint ramps and procedures to assure slow loading of variable load equipment and economizer modes to prevent unsafe overshoot of controlled pressure and unsafe undershoot of mixed air temperatures during start-up and transition periods.

C. Management Software:

1. Each equipment controllers shall be provided with a trend archive of at least the last 200 events (digital transitions or analog value changes) of any user selected group of up to 20 points. A stored event shall include date and time, and value or status. Point events shall be displayable at local panels as trend logs for evaluation of control system performance.
2. Each equipment controllers shall monitor analog input points and specified digital points for off-normal conditions. Each alarm shall have an "alarm delay" attribute which shall determine how long (in seconds) a point must be in an off-normal state prior to being considered in an alarm state.

D. Communications Software: Each equipment controllers shall have a full master peer-to-peer communications module to support global data sharing, hierarchical control, and global control strategies specified.

2.8 DATA COMMUNICATIONS

A. Equipment controllers shall be interconnected via a primary communications network. Terminal controllers shall also be connected together via secondary networks to provide data concentration and parallel processing. Networks shall support sensor sharing, global application programs, and bus-to-bus communications without the presence of a host PC.

B. The equipment controller's communications network shall support true peer protocol such that loss of any single device will not cause total bus failure.

C. Data connections for any control panels required in addition to those indicated on the Drawings

shall be the responsibility of this Section.

2.9 GENERAL

A. ATC setpoints, reset schedules, time programs, historical trends shall be displayable at local ATC panels and on the system's operator workstations.

B. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
   1. Binary Inputs: Allow monitoring of on-off signals without external power.
   2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
   3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
   4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with 3-position (on-off-auto) override switches and status lights.
   5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
   6. Tri-State Outputs: Provide two coordinated binary outputs for control of 3-point, floating-type electronic actuators.
   7. Universal I/Os: Provide software selectable binary or analog outputs.

C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
   1. Output ripple of 5.0 mV maximum peak to peak.
   2. Combined 1 percent line and load regulation with 100-microsecond response time for 50 percent load changes.
   3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

D. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
   1. Minimum dielectric strength of 1000 V.
   2. Maximum response time of 10 nanoseconds.
   3. Minimum transverse-mode noise attenuation of 65 dB.
   4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.10 SPARE POINTS

A. Provide a minimum of 10 percent spare points or 16 spare points, whichever is greater, in each ATC control panel for future use. Spare points shall be equally distributed among analog input, analog output, digital input and digital output. It is not intended that spare points be provided in unitary control panels which serve VAV boxes, unit ventilators, fan coil units and heat pumps. It is intended that spare points be provided in master control panels and in panels which serve boiler/mechanical rooms and major equipment such as air handling units.

2.11 CONTROL CABLE

A. Provide electronic and fiber-optic cables for control wiring in accordance with Division 27.

2.12 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.
   1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Manufacturers:
      a. Belimo.
      b. Schneider Electric DuraDrive
      c. Schneider Electric Andover Continuum Infinet II i2866 (with integral VAV controller)
   2. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
      a. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of at least 150 lbf-in. (16.9 N-m) and breakaway torque of at least 300 lbf-in. (33.9 N-m).
      b. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of at least 150 lbf-in. (16.9 N-m).
   3. Dampers: Size for running torque as recommended by the damper manufacturer for tight sealing under design operating static pressures and velocities. Submit damper manufacturer's torque chart in same submittal as actuator selection table.
      a. For dampers which do not list torque values, provide torque calculated as follows:
         1) Damper with Edge Seals: 7 inch-lb/sq. ft. (8.6 N-m/sq. m) of damper.
         2) Damper without Edge Seals: 5 inch-lb/sq. ft. (6.22 N-m/sq. m) of damper.
      b. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft (2.3 sq. m): Size for running torque of at least 150 lbf-in. (16.9 N-m) and breakaway torque of at least 300 lbf-in. (33.9 N-m).
      c. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft (2.3 sq. m): Size for running and breakaway torque of at least 150 lbf-in. (16.9 N-m).
      d. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by a factor of 1.5.
      e. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by a factor of 2.0.
   4. Coupling: V-bolt and V-shaped, toothed cradle.
   5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
   6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
   7. Power Requirements (2-Position Spring Return): 24-V ac.
   8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
   9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
   10. Temperature Rating: 40 to 104°F (5 to 40°C).

a. In addition, valve actuators shall be suitable for the anticipated ambient temperature and fluid temperature. For example, actuators located within heating equipment terminal enclosures will experience higher temperatures.

11. Temperature Rating (Smoke Dampers): -22 to 250 degrees F (-30 to 121 degrees C).
12. Run Time: 30 seconds.
13. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 degrees F (10 to 60 degrees C) unless located in return-air plenums.
14. Damper actuators shall be provided with end switches.

2.13 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
   1. Globe-type valves are required except for those applications where terminal-unit control valves or butterfly valves are specified or detailed.
   2. Ball-type valves may be substituted for other types, and shall be manufactured by Belimo, with Belimo actuators (no substitutions).
   3. Valves shall be suitable for water with up to 50 percent inhibited ethylene or propylene glycol.
   4. 3-way valves shall be mixing pattern, except where diverting pattern is specified, or where manufacturer requires use of diverting pattern.
   5. Rubber-paddle or ball-plug type control valves such as, but not limited to, Belimo Zone Valve, Honeywell Fan-Coil Valves or the TAC Erie product line (division of Schneider Electric) are not allowed.
   6. Valves with thermal-wax motors are not allowed.
   7. Valves requiring cartridge replacement for service are not allowed.
   8. Valves requiring special water treatment such as 50-micron filtration are not allowed.

B. Sizing: Maximum pressure drop determined with valve full-open at design flow rate and the following:
   1. 2 Position: Line size.
   2. 2-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 3 psig (21 kPa).
   3. 3-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 1.5 psig (10.5 kPa).
   4. Note: For modulating valves, the load pressure drop is that across the modulated portion of the system. For example, for a 3-way valve providing reset-water control at a boiler, the modulated flow is across the boiler and accessories, whereas the building loop to terminal equipment is considered constant-flow for the purposes of this valve's sizing. For a 3-way valve modulating the flow thru a coil, the coil and its pipe fittings comprise the variable-flow load. For a 3-way valve in a primary-secondary loop to a coil, where the flow thru the coil is a constant pumped flow, the variable load is in the primary-secondary bridge.

C. Hydronic system globe valves shall have the following characteristics:
   1. NPS 2 (DN 50) and Smaller: Class 125 bronze (or red brass) body, bronze or brass seat, bronze trim, rising stainless steel stem, renewable brass or composition disc or plug, screwed ends, with backseating capacity, repackable under pressure. Valve may have integral union ends. Valves with ends other than threaded or factory-integral unions are not allowed.

2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
    a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
    b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics through 1 of the ports, equal percentage through the other.
5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for 2-way valves, and 100 percent of pressure differential across valve or 100 percent of total system (pump) head for 3-way valves.
6. Temperature Rating: 250°F (121°C).

D. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Wafer or lug.
2. Disc Type: Nickel-plated ductile iron or aluminum bronze.
3. Seat: EPDM resilient seat replaceable. Disc may be coated, but primary sealing surface shall be the resilient seat mounted in the body.
4. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
5. Temperature Rating: 250°F (121°C).

E. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 ports as indicated, replaceable plugs and seats, and union and threaded ends. Valves with ends other than threaded or factory-integral unions are not allowed.
1. Applications: Duct-mounted reheat coils, unit heaters, cabinet unit heaters,. For other applications, see globe valve specifications above.
2. Honeywell "small linear control valves" with "linear valve actuators" (or equal) may be used only for VAV box coils and hot water duct coils; they may not be used for other coil or equipment types.
3. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
4. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating sufficient to close against pump shutoff head.
5. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics.

2.14 DAMPERS

A. Manufacturers:
1. Non-Insulated Dampers:
    a. Ruskin - Model CD60.
    b. American Warming & Ventilating.
    c. Arrow.
    d. Greenheck.
    e. Tamco (T.A. Morrison & Co., Inc.).
2. Insulated-Blade Dampers:

a. T.A. Morrison & Co., Inc.; Tamco Series 9000 SC “Severe Cold Option” dampers.
b. Ventex, Inc. - Series 3965 SC.

B. Non-Insulated Dampers:
1. AMCA-rated, parallel (2-position) or opposed-blade (modulating) design.
2. Frames shall be 16 gauge (1.6 mm) thick galvanized steel, reinforced to equivalent strength of 11 gauge (3 mm) galvanized steel; or 0.125 inch (3.2 mm) minimum thickness extruded-aluminum.
3. Blades shall be airfoil type of not less than 14 gauge (2 mm) equivalent thickness galvanized steel or heavy gauge extruded aluminum, with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
4. Secure blades to 1/2 inch (13 mm) diameter, hex-profile, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze or nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
5. Operating Temperature Range: From -40 to 200 degrees F (-40 to 9 degrees C).
6. Edge Seals, Low-Leakage Applications: Replaceable, inflatable blade edging of Ruskiprene, neoprene, vinyl, or rubber, and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm/sq. ft (50 l/s per sq. m) of damper area, at differential pressure of 4-inch wg (1 kPa) when damper is held by torque of 50 in.-l bf (5.6 N-m); when tested according to AMCA 500D-98.

C. Insulated Dampers: Dampers which are located in or 4 ft. (1.2 m) or less from outside walls or roof lines, and are 8 sq. ft. (0.74 sq. m) or larger, shall be thermally insulated type.
1. Frame: Extruded aluminum, externally insulated with polystyrene foam.
2. Blades: Double wall extruded aluminum, with internal injected polyurethane foam, thermally broken. Extruded silicone frame and blade seals, secured in slots in the aluminum extrusions. R-value of complete blade shall be 2.29 hr-ft2-F/Btu (0.39 m2- K/W).
3. Leakage shall not exceed 4.9 cfm/sq. ft (25 l/s per sq. m) against 4 in. wg (1 kPa) differential static pressure at -40 degrees F (-40 degrees C).
4. Bearings: Celcon inner bearing fixed to a 7/16 inch (11.1 mm) aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
5. Linkage Hardware: Installed in the frame side, constructed of aluminum and corrosion-resistant, zinc-plated steel, with cup-point trunnion screws for a slip-proof grip.
6. Operating Temperatures: -40 to 155 degrees F (-40 to 68 degrees C).
7. For dampers less than 12 inches (305 mm) in 1 dimension, provide “flanged-to-duct” mounting style for maximum free area.

D. Automatic dampers at exterior wall louvers shall be 4 inches (100 mm) shorter in vertical dimension (height) than the louver they serve, to allow sloping of bottom of duct to drain outward. Depending on the height of the louver’s integral waterstop, it may be necessary to slope the top of the duct as well as the bottom. Coordinate sizing and positioning of dampers and louvers with Division 23 Section “Air Inlets and Outlets” to ensure that base of damper frame is positioned higher than the lowest edge of the duct where it laps over the top edge of the louver’s waterstop or bottom blade. It shall be the responsibility of this Section to ensure proper installation to drain.

2.15 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:
   1. Accuracy: Plus or minus 0.5°F (0.3°C) at calibration point.
   2. Wire: Twisted, shielded-pair cable.
   3. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
   4. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
   5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64-mm).
   6. Room Sensor Cover Construction: See below.
   7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
   8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. Humidity Sensors: Bulk polymer sensing element.
   1. Accuracy: 2 percent full range with linear output.
   2. Room Sensor Range: 20 to 80 percent relative humidity.
   3. Room Sensor Cover Construction: See below.

D. Pressure Transmitters/Transducers:
   1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
      a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
      b. Output: 4 to 20 mA.
      c. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240-Pa).
   2. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
   3. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

E. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   1. Set-Point Adjustment: Concealed.
   2. Set-Point Indication: Concealed.
   3. Thermometer: Concealed.
   4. Communications Port: Standard phone-type jack for connection of portable laptop computer and other devices. Provide at each room sensor, no exceptions.
   5. Override Pushbutton: For timed override of occupied/unoccupied cycle. Provide in normally-occupied rooms such as shops, offices, cafeterias,. Do not provide in storage rooms, electrical rooms, Comm rooms, and mechanical rooms.

F. Room sensor accessories include the following:
   1. Insulating Bases: For sensors located on exterior walls.
   2. Adjusting Key: As required for calibration and cover screws. Furnish to the Owner, at least 5 per sensor type.

3. Wall Mounting Box: Recessed, steel, securely fastened to wall framing. Equal to Steel City metallic switch boxes by Thomas & Betts Corp. Box may only be omitted where sensor attaches directly to masonry construction.

2.16 THERMOSTATS AND TEMPERATURE SENSORS

A. Thermostats and Sensors in locations in regular view by the occupants shall have covers which are simple, aesthetically pleasing, neutral in color, with manufacturer's logo, if any, in black or neutral color, and shall fit flush to the surrounding wall surface.

B. Freezestats:
   1. Freezestat safety low limits shall be duct-mounted manual-reset and automatic-reset (see control sequences) 20-foot limited fill capillary-tube type, responsive to the coolest section of its length.
   2. Air handling systems which handle outside air (or a mix of outside air and return air) or are located outdoors shall have freezestats at hydronic and steam coils. Where freezestats are required, provide both a manual-reset type set near freezing temperature for shutdown, and an automatic-reset type set at a warmer temperature for preventive action

C. Thermostats
   1. Electric thermostats shall be line voltage or low voltage type, suitable for the application. They shall have exposed setpoint adjustment and setpoint indicator.
   2. Unit heater aquastats shall be strap-on type.

D. Temperature Sensors:
   1. Temperature sensors shall provide a 2-wire connection to the controller that is polarity and wire type insensitive. Sensors shall have communications jacks for connection to the communication trunk to which the controller is connected. The temperature sensor, the connected controller, and other devices on the communications bus shall be accessible by the Graphical Programming tool.
   2. Provide with manual adjustment rotary or sliding dials, with a scale labeled as either temperature in degrees F, or "warmer/cooler". The input from this dial shall be programmable through the operator workstation to allow a maximum and minimum range for user adjustment. The min/max range shall initially be set at 4°F above/below the programmed setpoint. When the dial is adjusted, it shall shift both heating and cooling setpoints by the programmed amount, in proportion to the distance moved. This dial shall only affect the occupied setpoints; the unoccupied setpoints shall remain as programmed.
   3. Provide with override buttons which, when depressed during unoccupied time periods, will override the zone's temperature controls and setpoints to occupied conditions for a user adjustable period of time (initially set for 2 hours).

2.17 STATUS SENSORS

A. Where differential pressure "sensor" is indicated or specified, they shall be analog-output type as specified herein. Where differential pressure "switch" is indicated, it may be digital-output type.

B. Status Inputs for Fans: Unless otherwise specified: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

C. Status Inputs for Pumps: Unless otherwise specified: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

D. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

E. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

F. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4-20 mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

G. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

H. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

I. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.18 CURRENT TRANSFORMERS

A. Current transformers (CTs) are not an acceptable substitute for pump or fan monitoring where flow switches or pressure switches are specified.

B. Provide CTs as required for the sequences of operation specified.

2.19 DIFFERENTIAL WATER PRESSURE SENSORS

A. Manufacturers:
1. Setra - Model 230 Wet-to-Wet Pressure Transducer.
2. Ashcroft.
3. Honeywell.
4. Johnson Controls.

B. At Contractor’s option, Setra Model 231RS wet-to-wet multi-range differential pressure transducer with remote-wired sensors may be used.

C. Differential-pressure monitoring shall be analog-output type unless otherwise specified.

D. High output, low differential pressure transducer designed for wet to wet differential pressure measurements of liquids or gases. A fast-response capacitance sensor and signal conditioned electronic circuitry provide a highly accurate, linear analog output proportional to pressure. Both unidirectional and bidirectional pressure ranges are available for applications with line pressure up to 250 psig.

E. An isolation system transmits the motion of the differential pressure sensing diaphragm from the high line pressure environment (e.g. corrosive liquids) to the dry (air) enclosure where it moves one of a pair of capacitance plates proportionally to the diaphragm movement. Response to pressure changes is approximately 20 times faster than conventional fluid-filled transducers. The electronic circuit linearizes output vs. pressure and compensates for thermal effects of the sensor.

F. NEMA 4/IP65 rated enclosure. Pipe-thread fittings.

G. Accuracy RSS (of non-linearity, non-repeatability and hysteresis) (at constant temperature) +/- 0.25 percent of full scale (pressure range).

H. Pressure Range: Selected by the Contractor for the anticipated or field-measured (actual) pressure differential. Lower ranges have greater accuracy.

I. Ambient Operating Temperature for Electronics: 0 to 175°F (-18 to 79°C).

2.20 DIFFERENTIAL WATER PRESSURE SWITCHES

A. Differential-pressure switches with on/off contact closure output may be used where specified.

B. NEMA 2minimum enclosure. Pipe-thread fittings. Brass or bronze wetted parts.

C. Ambient Operating Temperature for Electronics: 30 to 158°F (-1 to 70°C).

2.21 ROOM OCCUPANCY DETECTION EQUIPMENT

A. Carbon Dioxide Sensor and Transmitter: See “Carbon Dioxide Sensor” in this Section.

B. Occupancy Sensor: Provided by Division 26.

2.22 REFRIGERANT LEAK DETECTORS

A. Manufacturers:
1. Bacharach, Inc. - HGM-MZ multizone.
2. Parasense, Inc.

B. Product Type: Multiple-area monitoring system for low level continuous monitoring of refrigerant gases used in most commerial systems including: CFC, HCFC, HFC and Ammonia. System design supports compliance with gas monitoring requirements of ANSI/BSR ASHRAE 15-1994.
1. Detector shall be compatible with refrigerant type as scheduled.

C. Front Panel: 3 indicator lights.
1. Green: Monitor is powered on. LED glows during normal operation; flashes when unit is in warm-up mode.
2. Red: Alarm. LED flashes when any point has exceeded the alarm setting.
3. Yellow: Fault. LED flashes when there is a system fault.

D. Performance:
1. Sensitivity: 1 ppm (exception is R11: +/- 10 ppm +/- 15 percent of reading 0-1000

ppm).
2. Measuring Range: 0 to 10,000 ppm.
3. Accuracy: +/- 1 ppm from +/- 10 percent of reading from 1-1000 ppm (exception is R-11: +/- 10 ppm +/- 15 percent of reading 0-1000 ppm).
4. Temperature Drift: +/- 0.3 percent of reading per degree C.
5. Coverage: 4 point (zone) standard, expandable to 16 points in 4 point increments.
6. Detector Type: Infrared Non-Dispersive.
7. Sampling Mode: Automatic or Manual (hold).
8. Re-Zero: Auto or on Zone Change.
9. Response Time: 5 to 120 seconds - depending on air-line length and number of zones.
10. System Noise: Less than 40 dB(A) at 10 feet (3 m).
11. Monitoring Distance: 1,200 ft. maximum for combined length of sample + exhaust tubing (each zone).
12. Conditional System: Dual optional 4-20 mAdc isolated outputs. Channel 1: zone area. Channel 2: PPM.
13. Alarms:
    a. 4 SPDT alarm contacts (rated 5 Amps at 250 volts). 3 assigned to PPM level alarms, 1 assigned to system faults.
    b. Audible alarm at panel, with silencing feature.
14. Communications: RS-232C communication port standard. Provide full 2-way communication with building management system via RS485 MODBUS-RTU serial interface.
15. Power Safety Mode: Fully automatic system reset. Programmed parameters retained
16. Operating Temp: 32 to 122°F (0 to 50°C).
17. Ambient Humidity: 5 to 90 percent RH (non-condensing).
18. AC Power: 100 to 240 VAC, 50/60 Hz, 20 W.
19. Altitude Limit: 6,562 ft. (2,000 m).
20. Fusing: F1, F2: 1.0 A, 250 VAC, Type “F”.
21. Sensor Life: 7-10 years.

E. Certification: UL 61010-1, Can/CSA 22.2 No. 61010-1 & CE Mark.

F. Warranty: 2 years from date of shipment.

G. Accessories:
1. Surge protector.
2. Tubing and supports for sample intake lines, purge line, and exhaust line.
3. End-of-line filters.
4. Charcoal filter for purge line.
5. Splitter kits for multiple filters on a single zone.
6. Water trap.
7. Spare fuses.
8. Annual maintenance kit, including line end filters in quantity to match installation, 1 charcoal filter, 1 hydrophobic filter, and 3 end-of-line water stop filters.

H. For installation of relief valve end-of-line filter, provide end of relief copper piping turned downward to shed water and snow, and enlarge end of piping so that net area of piping with filter installed is not less than the area of the relief main.

2.23 AIRFLOW MEASURING STATIONS

A. Manufacturers:
   1. EBTRON, Inc. Model GTx116 P and GTx116 F (basis of design).
   2. Air Monitor Corporation.

B. Verify quantities, sizes, and locations of measuring stations to meet the intent of the specified control sequences, and provide as required, whether or not they are indicated on the Drawings. Coordinate with other Sections of the Specifications and other trades, to provide installation in ductwork, air handling units, and other locations as required.

C. Warranty: Provide a manufacturer's parts warranty for 36 months from the date of unit shipment.

D. Submittals:
   1. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system.
   2. Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this Specification throughout the measurement range.
   3. Submit a schedule of airflow measuring devices indicating compliance with specified accuracy at minimum and maximum airflow rates.
   4. Submit installation, operation and maintenance documentation.

E. Each measurement device shall consist of one or more sensor probe assemblies and a single microprocessor based transmitter. Each sensor probe assembly shall contain one or more independently wired sensor housings. Multiple sensor housings shall be equally weighted and averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.

F. Air flow measuring assemblies shall be selected and arranged to minimize the number of probes and sensors required for the size of the duct.

G. Sensor Probe Assemblies:
   1. Each sensor housing shall be manufactured of a U.L. listed engineered thermoplastic.
   2. Each sensor housing shall utilize two hermetically sealed, bead in glass thermistor probes to determine airflow rate and ambient temperature. Devices that use "chip" type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
   3. Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/- 2 degrees F of reading over the entire operating airflow range. Each sensor assembly shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
      a. Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this Specification throughout the measurement range.
   4. The operating temperature range for the sensor probe assembly shall be 20 to 160 degrees F (-28 to 71 degrees C). The operating humidity range for the sensor probe assembly shall be 0 to 99 percent RH (non-condensing).

5. Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/- 0.15 degrees F (0.08 degrees C) over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
6. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to a remotely mounted transmitter. Terminal plug interconnecting pins shall be gold plated.
7. Each sensor assembly shall not require matching to the transmitter in the field.
8. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.

H. Duct and Plenum Sensor Probe Assemblies:
1. Sensor housings shall be mounted in an extruded, gold anodized, 6063 aluminum tube probe assembly.
2. The number of sensor housings provided for each location shall be as follows:

a. Area (sq.ft.)	Area (sq.m)	Sensors
≤1	(≤0.09)	2
>1 to <4	(>0.09 to <0.37)	4
4 to <8	(0.37 to <0.74)	6
8 to <12	(0.74 to <1.11)	8
12 to <16	(1.11 to <1.49)	12
≥16	(≥1.49)	16

3. Probe assembly mounting brackets shall be constructed of Type 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
a. Insertion mounted through the side or top of the duct.
b. Internally mounted inside the duct or plenum.
c. Standoff mounted inside the plenum.
d. The operating airflow range shall be 0 to 5,000 fpm (0 to 56 m/s) unless otherwise indicated on the Drawings.

I. Fan Inlet Sensor Probe Assemblies:
1. Sensor housings shall be mounted on 304 stainless steel blocks.
2. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
3. Mounting feet shall be constructed of 304 stainless steel.
4. The operating airflow range shall be 0 to 10,000 fpm (0 to 113 m/s) unless otherwise indicated on the Drawings.

J. Transmitters:
1. The transmitter shall have an LCD display capable of displaying airflow and temperature. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
2. The transmitter shall be capable of displaying the individual airflow and temperature readings of each sensor on the LCD display.
3. The transmitter shall operate on 24 VAC. The transmitter shall not require an isolated power source.
4. The operating temperature range for the transmitter shall be 20 to 120 degrees F (-28 to 48 degrees C). The transmitter shall be protected from weather and water.
5. The transmitter shall be capable of communicating with the host controls using one of the following interface options:
a. Linear analog output signal: Field selectable, fuse protected and isolated, 0 10VDC and 4 20mA (4 wire).

b. RS 485: Field selectable BACnet MS/TP, ModBus RTU and Johnson Controls N2 Bus.
c. 10 Base T Ethernet: Field selectable BACnet Ethernet, BACnet IP, ModBus TCP and TCP/IP.
d. LonWorks Free Topology.

K. The measuring device shall be UL listed as an entire assembly.

L. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the Drawings. Submit a written report to the Architect if any measurement locations do not meet the manufacturer's placement requirements.

M. Airflow measuring stations shall be interfaced so that the building's ATC system shall monitor airflow. Coordinate output signal with the ATC system's requirements. Any controllers required for the proper operation of the airflow monitoring station shall be LonWorks compliant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply and data outlet is available to control units and operator workstation.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. The ATC Contractor shall be responsible for electrical installation, including any low voltage and line voltage wiring which is required for a fully functional control system and not indicated on the Electrical Drawings or required by the Electrical Specifications (Divisions 26 and 27).

B. Wiring and conduits shall be properly supported and run in a neat and workmanlike manner. Wiring and conduits exposed and in equipment rooms shall run parallel to or at right angles to the building structure. Wiring and conduits within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. Wiring, conduits, wall boxes, and accessories shall conform to Division 26 – Electrical, and Division 27 of the Contract Documents.

C. Wiring shall be in accordance with local and national Codes and regulations.

D. Provide electrical materials and installation under this Section. Requirements and standards shall be as specified in other Sections and Divisions of the Specifications, as indicated in paragraphs below.
1. Install raceways, boxes, and cabinets in conformance to Division 26.
2. Install building wire and cable in conformance to Division 26.
3. Provide interface wiring (line and low voltage) as required to complete ATC system installation.
4. Install signal and communication cable according to Division 27.
   a. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   b. Install exposed cable in raceway.

c. Install concealed cable in raceway.
d. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
e. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
f. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
g. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

E. Control wiring in boiler room, mechanical rooms, and equipment rooms shall be installed in conduit which shall comply with the requirements of the Electrical Specifications.

F. Electronic low-voltage wiring shall be #18 AWG minimum THHN and shielded if required.

G. Provide power for normally-open duct reheat coils, hot water valves. De-energize valves when hot water pumps are de-energized.

H. Power for any temperature control panels required in addition to those indicated on the Drawings shall be the responsibility of this Section. Power to temperature control panels shall be through "stand-by" power circuits which are powered through the building's emergency generator.
1. It is the design intent to have the entire temperature control system, including damper and valve actuators, powered by stand-by power circuits to ensure that the DDC system is fully functional when the building is operating on generator power.
2. The following HVAC equipment will be powered by stand-by circuits and shall remain in control when the building is operating on generator power:
a. Boilers
b. Heating water pumps.
c. The entire automatic temperature control system.
3. Air Handling Unit

3.3 INSTALLATION

A. Wall mounted thermostats and temperature sensors shall be attached to an electrical wall box attached to a wall stud, masonry wall, or to blocking. Attaching to gypsum wallboard only shall not be allowed.

B. Mounting heights of room sensors, thermostats, and other devices, which have features which occupants may adjust or set by touching, shall be installed in locations and heights conforming to U.S. Department of Justice – 2010 ADA Standards for Accessible Design.
1. Unobstructed Forward or Side Reach: Reaches, measured by distance above the finished floor or ground surface upon which the occupant shall be sitting or standing, shall be a high of 46 inches (1220 mm) maximum measured to the center of the device.
2. Obstructed High Reach: Where the reach depth exceeds 20 inches (510 mm), the high forward reach shall be 42 inches (1120 mm) maximum to the center of the device and the reach depth shall be 25 inches (635 mm) maximum.
3. Coordinate with Division 26 – Electrical to match heights for an aesthetically pleasing appearance.

C. Verify location of room temperature sensors and other exposed control sensors with Drawings

and room details before installation.

1. Thermostats and temperature sensors are indicated on the Drawings for general location. Terminal heat transfer units and fans which control space temperature shall be provided with thermostatic control, whether or not a thermostat or temperature sensor has been indicated on the Drawings.
2. Locate in the general location indicated, and coordinate to group together with room light switches and other devices of similar height, to minimize disruption of open wall space.
3. Locate to not be above electrical dimmers.
4. Locate to avoid heat-generating equipment such as computers, copiers, cooking equipment, coffee makers, vending machines, and refrigerators. Where electrical outlets are indicated near sensors, verify whether equipment is intended.
5. Locate to avoid heating piping which may be concealed in partitions.
6. Locate away from windows and exterior doors.
7. Locate to avoid other false sources of heat such as strong sunlight.

D. Provide guards on room sensors and thermostats in the following locations:

1. Locations vulnerable to traffic.
2. Where indicated.

E. At each wall-mounted temperature sensor, provide wiring for setpoint dial and override pushbutton, and for communications jacks, whether or not the specified sensor has these functions. This will allow the Owner to change sensors to add these functions in the future. Provide access to the associated controller and related control panels through each communication jack.

F. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

G. Install freezestats serpentined across and clipped to the downstream face of coils. Entire length of capillary tube shall be within the unit airstream.

H. Perform adjustment/relocation of freezestats as required to eliminate nuisance freezestat alarms.

I. Aquastats installed on unit heaters and at any location above 60 inches (1525 mm) above finished floor shall be installed with adjustment knobs facing downward to facilitate adjustment.

J. Outdoor air temperature sensor(s) shall be installed on the North side of the building.

K. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

L. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

M. Connect lead-lag controls to lock out the failed or non-selected motor, to prevent simultaneous operation.

N. Connect lead-lag controls so that only 1 motor can run in starter “hand” position.

O. Connect fire alarm shutdown of motors on the load side of controls and hand-off-auto switches,

to prevent motor from running in any switch position during fire alarm.

P. For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

Q. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
   1. Sensors shall be immersion type in wells unless otherwise specified or indicated.
   2. Enlarge piping at wells to prevent excess interference with flow.
   3. Locate wells to ensure insertion in active flowing section of piping or tank.
   4. Fill sensor wells with Honeywell thermal heat transfer paste to ensure good conduction.
   5. Locate sensors wells at or above the 90° level on piping systems to prevent sediment build up.

R. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping and Specialties."

S. Install automatic dampers in conformance to Division 23 Section "Air Duct Accessories."

T. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures. Provide stand-off brackets of depth to meet or exceed specified thickness of duct insulation.

U. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

V. Provide labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

W. Install electronic and fiber-optic cables according to Division 27.

X. Unless otherwise indicated, actuators shall be spring loaded and shall, upon a loss of power, actuate their device to an appropriate “fail safe” position.
   1. Hot water valves - fail safe to fully open.
   2. Outside and exhaust air dampers - fail safe to fully closed.
   3. Exhaust fan motorized dampers - fail safe to fully closed.
   4. Supply air dampers at rooftop units - fail safe to fully closed.
   5. Return air dampers - fail safe to fully open.
   6. Boiler isolation valves (each boiler) - fail safe to fully open.

Y. For actuators that are required to “fail safe”, provide spring return actuators. “Floating point” actuators shall not be allowed for these applications. “Floating point” actuators shall be allowed for actuators that are not required to “fail safe”.

Z. Enter computer programs and data files into the related computers including control programs, initial approved parameters and settings, and English descriptors.

AA. Maintain CD copies of data file and application software for reload use in the event of a system crash or memory failure. 1 copy shall be delivered to the Owner during training session, and 1 copy shall be archived in the ATC Contractor's local software vault.

BB. Install software in control units and operator workstation(s). Implement features of programs to specified requirements and as appropriate to sequence of operation.

CC. Connect and configure equipment and software to achieve sequence of operation specified.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   2. Test and adjust controls and safeties.

C. DDC Verification:
   1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
   2. Check instruments for proper location and accessibility.
   3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
   4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
   5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
   6. Check temperature instruments and material and length of sensing elements.
   7. Check control valves. Verify that they are in correct direction.
   8. 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.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:
   1. Calibrate instruments.
   2. Make 3-point calibration test for both linearity and accuracy for each analog instrument.
   3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
   4. Control System Inputs and Outputs:
      a. Check analog inputs at 0, 50, and 100 percent of span.
      b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
      c. Check digital inputs using jumper wire.
      d. Check digital outputs using ohmmeter to test for contact making or breaking.
      e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a

precision-resistant source.

5. Flow:
   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to 3 visits to Project during other than normal occupancy hours for this purpose.

3.6 VALIDATION

A. The ATC Contractor shall completely check out, calibrate, and test connected hardware and software to insure that the system performs in accordance with the approved submittals for specifications and sequences of operations.

B. Witnessed Validation Demonstration: Shall consist of:
1. Display and demonstrate each type of data entry to show site specific customizing capability.
2. Execute digital and analog commands.
3. Demonstrate ATC loop precision and stability via trend logs of inputs and outputs.
4. Demonstrate energy management performance via trend logs and command trace.
5. Demonstrate that each control point, tag, or address is associated with the proper device, such as a room sensor input or an actuator output. This demonstration shall include visual confirmation that the measured values and the output actions match what is indicated in the control system.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Mechanical instrumentation and controls.

3.8 TRAINING

A. Training shall be by the ATC Subcontractor and shall utilize specified manuals and as-built documentation. Video record each training session, and turn the completed video over to the Owner when training has been completed.

B. Operator training shall include 10 four-hour sessions encompassing:
   1. Modifying text.
   2. Sequence of Operation review.
   3. Selection of displays and reports.
   4. Use of the specified functions.
   5. Setting and adjusting of occupancy schedules.
   6. Troubleshooting of sensors.
   7. Owner questions/concerns.

C. 2 training sessions shall be conducted at project substantial completion, and the others shall be conducted at the Owner's request and in accordance with the Owner's schedule within a period of 6 months after substantial completion of the project.

D. At 6 months after substantial completion, unused training hours shall be, at the Owner's discretion, used for future training of new personnel or reimbursed to the Owner at the Subcontractor's current hourly service rate.

3.9 MECHANICAL COMMISSIONING

A. Refer to Specification for requirements and responsibilities of the ATC Contractor.

B. Prior to the commencement of mechanical commissioning, provide validation of the temperature control system as follows:
   1. Completely check out, calibrate, and test connected hardware and software to insure that the system performs in accordance with the approved products and sequences of operations submitted.
   2. Witnessed validation demonstration shall consist of:
      a. Display and demonstrate each type of data entry to show site specific customizing capability.
      b. Execute digital and analog commands.
      c. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs.
      d. Demonstrate energy management performance via trend logs and command trace.

C. To facilitate the commissioning process, provide the ability for the Commissioning Agent to, through the graphics screens, modify the outside air temperature analog input signal to the system. The intent is to allow the Commissioning Agent to adjust the outside air temperature so that the systems can be tested during their various modes of operation (for example, dehumidification, humidification, heating, cooling.)

D. Provide support for the Commissioning Agent as required to facilitate the commissioning process. This shall include a minimum of 2 four-hour training sessions on the use of the system's graphics and associated software. The intent is to train the Commissioning Agent so that he can perform simple commands such as adjusting room temperature setpoints for commissioning of reheat coils, fintube radiation, cabinet unit heaters, unit heaters and VAV boxes. This will allow the Commissioning Agent to perform a majority of his work without

assistance. For more complicated systems such as building pressure control, control of outdoor air dampers based on CO_2 levels, control of variable frequency drives and air handling unit damper response, provide assistance as required by the Commissioning Agent during the commissioning process.

PART 4 - SEQUENCE OF OPERATION

4.1 GENERAL

A. Setpoints shall be adjustable by the building operator through the graphic interface on the operator's workstation desktop PC, and through a portable laptop computer plugged into the system at locations throughout the building.

B. Provide the ability for the Commissioning Agent and the Testing and Balancing Agent to connect to the system and change setpoints, to temporarily override setpoints, and to override modes of operation, as may be required for their work.

4.2 ALARMS

A. In addition to alarms specified in the following sequences, provide alarms as follows. Program alarms selected by the Owner to initiate a signal to the Owner's off-site building security company, and to designated agents such as company employees.
   1. Room low temperature alarm.
   2. Room high temperature alarm.
   3. Boiler failure alarm.
   4. Pump failure alarm (both pumps in lead-lag situations).

4.3 OCCUPIED/UNOCCUPIED MODE

A. Provide as a minimum the following zones of occupied/unoccupied control, each with its own time-of-day and calendar sequences:
   1. Areas served by AHU-1 and AHU-2.and associated exhaust fans in toilet areas.

B. When occupied/unoccupied override buttons on space sensors are pressed, the mode for that space and associated toilet rooms shall change to occupied mode for 2 hours (adjustable). System shall maintain a log of where and when the buttons are pressed during unoccupied times, but shall not log if button is pressed during occupied time.

C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
   1. Identification of room where button was pressed.
   2. Identification of systems in override status.
   3. Override time remaining.

4.4 HEATING/COOLING MODE

A. Heating Mode:
   1. Heating mode is automatically enabled when outside air temperature drops below setpoint (60°F, adjustable) or when there is a call for heating from any 2 (quantity adjustable) zones or more, or from the low-temperature alarm in any space. Heating

mode is automatically disabled when the outside air temperature rises above setpoint.

2. Heating control valves are powered from dedicated circuits. When the hot water pumps are disabled, control power to the valves is de-energized, allowing the valves to go to failsafe position. This is to prolong actuator life by turning them off in warm weather.

B. Cooling Mode:
   1. Cooling system is automatically enabled when outside air temperature rises above setpoint (10°F, adjustable) or when there is a call for cooling from the room sensor or the high-temperature alarm in any space. Cooling mode is automatically disabled when the outside air temperature drops below setpoint, if no space is calling for mechanical cooling.
   2. Cooling mode is enabled by the DDC system when there is a call for mechanical cooling. Economizer cooling is the first stage of cooling. For systems which have economizer cooling, mechanical cooling is locked out when outside air temperature is below 45°F (adjustable).

C. Deadband (Zero-Energy Mode): In spaces and systems with both heating and cooling setpoints, there shall be a difference of at least 4°F between temperature setpoints, unless otherwise specified. When the sensed temperature or humidity is between the heating and cooling setpoints, the system shall operate with no heating hot water or cooling except as required to maintain the status quo.

D. Provide manual override points on the graphics screen to allow the Owner to override the automatic heating and cooling modes.

4.5 HEATING SUPPLY WATER TEMPERATURE CONTROL

A. Gas-fired hot water boilers are operated independently of any other system controls.
   1. Boiler B-1:
      a. The boiler is enabled on based on system demand.
      b. When a boiler is energized, its gas burner fires (fully modulating) to maintain setpoint (140°F, adjustable).
      c. When a boiler is energized and its temperature is within 15°F of setpoint, its return control valve opens.
      d.
   2. The ATC monitors boiler safeties including low water cutoff and flame failure.

B. Loop Temperature Control:
   1. When a boiler is energized and its temperature is within 15°F of setpoint, its injection pump (BP-1) is enabled.
   2. The heating water supply setpoint is reset based on outdoor air temperature, in a supply temperature range of 120 to 140°F over an outdoor range of 0 to 55°F.

C. The following points and associated control wiring are provided under this Section. Coordinate with boiler controller manufacturer. Provide control wiring required for interface between automatic temperature control system and boiler controllers. Coordinate control signal with boiler controller manufacturer.
   1. Analog input to receive signal from lead/lag controller for calculated system target temperature. Use this signal for control of lead boiler burner.
   2. Analog input to receive signal from lead/lag controller for boiler temperature (each boiler).

3. Digital input to receive signal from lead/lag controller for burner command status (on/off).
4. Digital input to receive signal from lead/lag controller for burner status (on/off /alarm).
5. Digital input to receive signal from lead/lag controller for lag boiler status.
6. Digital output to lead/lag controller to enable/disable boiler system.

D. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
1. Boilers:
   a. Boiler command enable status.
   b. Boiler burner call for heating.
   c. Water temperature in each boiler (immersion sensor in the boiler adjacent to boiler's control aquastat).
   d. Outdoor temperature.
   e. Reset function setpoints.
2. Building load side of system:
   a. Hot water supply manifold temperature.
   b. Hot water return manifold temperature.
   c. Hot water return temperature to boilers.
   d. VFD reference command speed.
   e. VFD actual speed.
   f. VFD alarms.
   g. Room temperature.
   h. Room cooling exhaust fan command.
   i. Room cooling exhaust fan status.

4.6 HOT WATER CIRCULATING PUMPS (P-1)

A. Pumps are started and stopped through the DDC system. The lead pump runs continuously in heating mode.

B. The variable frequency drive modulates pump speed to maintain system differential pressures.
1. Provide differential pressure sensors at remote locations at least 3/4 of the total system distance from the pumps, and where indicated, including one set for each phased area as required.
2. Differential pressure setpoints are determined by the Testing and Balancing (TAB) Agent and are the value at which design water flow is achieved at each sensor.
3. The system has the capability to operate on a single sensor selected by the operator. It is also able to operate on 2 or more sensors selected by the operator, responding to the sensor which has the greatest deviation from setpoint.
4. When the differential pressure sensor(s) call for increased pressure, the variable frequency drive for the lead pump modulates the pump motor speed from minimum to maximum to maintain the differential pressure setpoint.
5. The ATC system monitors VFD status, and other data. If a VFD indicates trouble, an alarm is generated. If the lead-pump VFD indicates trouble, the lead pump and its VFD are locked out and the lag pump is energized.

C. Differential pressure sensors at each pump monitor pump operation and generate an alarm if differential pressure falls below minimum set point, with time delay on start-up and lead pump

switch-over.

D. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
   1. Circulating Pumps P-1:
      a. Heating system and pump demand on/off.
      b. pump selection status.
      c. pump manual selection.
      d. Pump status by differential pressure.
      e. pump trouble (alarm).
      f. pump failure (critical alarm).
      g. Pump run time in hours.
      h. VFD reference speed.
      i. VFD actual speed output.
      j. VFD power/amps.
      k. VFD trouble alarm.
      l. Alarm silencing.

   2. Building piping loop:
      a. Differential pressure setpoint at each remote sensor.
      b. Differential pressure reading at each remote sensor.
      c. Selection of one or more remote DP sensors to control pump speed.

4.7 AIR HANDLING UNIT

A. The unit is DDC controlled using electric actuation.

B. The air handling unit is scheduled for automatic operation on a time of day basis for Occupied and Unoccupied modes.
   1. Within the Occupied mode, the system can enter:
      a. Warm-Up mode:
         1) When zone space temperature is below set point.
         2) The system stays in the Warm-Up mode until the mode set point is satisfied.
      b. Cool-Down mode:
         1) When zone space temperature is above set point.
         2) The system stays in the Cool-Down mode until the mode set point is satisfied.
   2. Within the Unoccupied mode, Night Heating is available when the space temperature drops below space unoccupied heating set point (3 degrees adjustable below radiant floor heat setpoint). The latest start time is the scheduled occupancy for the space.

C. The air handling unit operates in Warm-Up, Cool-Down, Occupied, Unoccupied, Night Heating, Cooking (AHU-2 only) and Safety modes as follows (suggested set points and settings are Owner-adjustable)
   1. Optimum Start
      a. The warm-up mode begins at a time calculated by the DDC system based on trends of outdoor temperature, time required to warm up/cool down, and current outdoor temperature.
   2. Warm-Up Mode
      a. The supply and return fans start. The return air mixed air dampers are positioned for 100 percent return air. The heating coil valve opens 100 percent and remains

open until the return air temperature reaches 70°F. If time reaches the latest start time during the Warm-up mode, the outdoor air damper opens to the minimum position. The system is prevented from entering the Warm-up mode more than once per day.

3. Cool-Down Mode
   a. The supply and return fans start. The return and mixed air dampers are positioned for 100 percent return air. The associated condensing unit operates at 100 percent and until return air temperature reaches 74°F. If time reaches the latest start time during the Cool-Down mode, the outdoor air damper opens to its minimum position. The system is prevented from entering the Cool-Down mode more than once per day.
4. Occupied Mode
   a. The fans start or continue to run. Position return air damper and the mixed air damper open and the relief damper and the outdoor air damper open to minimum position (225 cfm for AHU-1 & 300 cfm for AHU-2). The heating valve and condensing unit modulate to maintain space set point.
   b. As the first stage of cooling, when outside air enthalpy is lower than return-air enthalpy, the differential-enthalpy economizer modulates the economizer outside air damper and the return damper for up to 100 percent outside air. The maximum amount of outside air and damper position are set in cooperation with the ARU manufacturer's representative and the TAB Agent; it may be beneficial to limit this to less than 100 percent to encourage rotation of the room air, and/or to help control room pressurization.
   c. As the second stage of cooling, the condensing unit modulates to maintain setpoint.
   d. Both economizer and mechanical cooling can operate simultaneously.

5. Unoccupied Mode (Normal Off)
   a. The supply and return fans stop. The outside air and relief dampers close and the heating coil valve opens to 10 percent (Owner-adjustable) if outside air temperature is below 45°F. Heating coil valve shall close if outside air temperature is above 45°F.
6. Night Heating
   a. The air handling unit shall operate when the space set point falls 5 degrees F below night setback temperature. If this should occur, the supply and return fans start with the heating coil valve modulating to maintain an 85°F discharge air temperature. The air handling unit shall remain on until the zone is satisfied. The outside air and relief dampers remain closed.
7. Cooking (AHU-2 only)
   a. The air handling unit shall operate in cooking mode when the range hood is in use. The air handling unit runs in occupied mode except for the outdoor damper opens to 500 cfm. The damper remains in this position until the range hood turns off.
8. Night Cooling: cooling is de-energized during the unoccupied mode.

D. Supply and Return Fan Control
   1. The supply fan variable frequency drive shall modulate the supply fan between minimum and maximum air flow.
   2. The return fan variable frequency drive shall modulate the return fan to maintain an air flow, equal to 90 percent of the total supply air flow minus any exhaust in the associated AHU system. Return fan air flow shall be determined by the TAB Agent.
   3. Upon initial startup of the air handling unit, the supply and return fans slowly ramp to the

desired static pressure set point. Upon shutdown of the air handling unit, the supply and return fans slowly stop and the speed reset signal goes to zero speed.

E. Filter Pressure Drop Monitoring: A filter pressure switch monitors the pressure drop across the filters, with separate switches for prefilters and final filters, and generates a service message specific to each switch when the pressure drop exceeds setpoint. Setpoints shall be at the filter manufacturer's midrange of serviceable pressure drop, not at the maximum allowable drop.

F. Safeties
1. High limit static pressure sensor (set at 1 inch wc static pressure higher than scheduled external static pressure) in both supply and return mains shall de-energize the supply and return fans upon activation and shall activate an alarm.
2. An automatic reset, capillary tube type freezestat is installed downstream of the heating coil. This freezestat is set to trip at a temperature which is 5 degrees F higher than the manual reset freezestat located downstream of the heating coil. When this freezestat is tripped, the air dampers are placed in 100% recirculation air mode for a period of 15 minutes (Owner-adjustable). After 15 minutes have elapsed, the outside/ mixed air dampers are allowed to modulate open to normal control.
3. Air flow switches are installed in the ductwork for each supply and return fan. The DDC system uses the switches to confirm the fans are in the desired state (on or off) and generates an environmental alarm if status deviates from DDC start/stop control.

4.8 AIR HANDLER OPERATOR STATION DISPLAY:

A. Application: AHU.

B. At a minimum, indicate the following on operator workstation display terminal:
1. Supply and return fan status.
2. Supply and return fan air flow.
3. Supply and return fan VFD status.
4. Supply duct static pressure.
5. Supply duct static pressure set point.
6. High limit supply and return static status.
7. 2 position outdoor air and exhaust air damper status.
8. Modulating return, exhaust, and mixing air damper status.
9. Supply and return smoke detector status.
10. Outdoor, return, mixed, and supply air temperature.
11. Supply air set point temperature.
12. Heating valve position.
13. Condensing unit status.
14. Automatic and manual freeze stat status.
15. VFD speed command.
16. VFD actual speed.
17. Hot water coil pump command.
18. Hot water coil pump proof (differential pressure sensor).
19. Occupied override status.
20. Warm up status.
21. Cool down status.
22. Alarms.

4.9 CABINET UNIT HEATERS (CUH)

1. Space sensor: Wall-mounted, except where sensor is indicated on the Drawings to be mounted in unit return air. Blank cover, without setpoint dial or thermometer.
2. Setpoint: Provide occupied/unoccupied control. Initial setpoints (adjustable):
3. Cabinet Unit Heaters in spaces with exterior doors (most Stairs and , Entries, and Vestibules): 65°F occupied/55°F unoccupied.
4. Cabinet Unit Heaters in Vestibules:
5. 60°F occupied/50°F unoccupied.
6. Heating in Vestibules shall be disabled when outside air temperature rises above 55 deg F.
7. Cabinet Unit Heaters in spaces without exterior doors: 68°F occupied/60°F unoccupied.
8. Fan cycles on demand from space sensor. 2-way or 3-way (as indicated) control valve opens on demand from space sensor, and strap-on return aquastat cycles the fan. Provide strap-on aquastat (location: on return piping unless otherwise detailed) set at 100°F (adjustable) to prevent fan operation when hot water is not available.
9. Mount strap-on aquastat in orientation to be most readily visible from the floor. Insulate over the sensor bulb.
10. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
11. Space temperature.
12. Unit on/off command.

4.10 DUCTLESS SPLIT SYSTEMS AND MINI-SPLIT SYSTEMS

A. Space sensor: Wall-mounted, blank cover, without setpoint dial or thermometer.

B. The factory-furnished hard-wired wall-mounted controller cycles the indoor fan on a call for cooling (setpoint 75°F, adjustable). The rooftop condensing unit compressor and its condenser fan cycle as required. The Mechanical Subcontractor is responsible for controller setup and programming.

C. The wall-mounted sensor monitors space temperature.

D. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
   1. Space temperature.

4.11 EXHAUST FANS

A. Space sensor: Wall-mounted, blank cover, without setpoint dial or thermometer.

B. Fan status is monitored by current sensors.

C. When a fan associated with an AHU is placed in the occupied mode of operation, the fan’s motorized damper opens. The fan is commanded on upon closure of the damper auxiliary switch. When the air handler is in the unoccupied mode, the fan is commanded off and its respective motorized damper closes. Configure controls to allow control and override of these fans through the operator workstation graphics.

D. General Exhaust Fans: General exhaust is on a time-of-day function. The motorized damper opens; when the damper auxiliary switch closes, the fan starts.

E. Electrical Rooms, Boiler Room, and Chiller Room Cooling: As space temperature increases above setpoint (80°F, adjustable), the fan's motorized damper opens, and associated intake louver or hood dampers (if any) open. When the fan damper auxiliary switch closes, the fan starts. When space set point temperature is satisfied, the fan is commanded off and the dampers close.

F. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
1. Exhaust fan on/off command.
2. Exhaust fan airflow status.
3. Damper auxiliary switch open/closed.
4. Fan alarm status.
5. Space temperature where required.
6. Space set point where required.
7. Leak detection warning and critical alarm status, and reset points.

4.12 RADIANT FLOOR

A. Space sensor: Wall-mounted, blank cover, without setpoint dial or thermometer.

B. Slab sensor: Remote sensing element embedded in the floor slab, ruggedized type, centered between rows of tubing, 6 to 12 feet from outside wall.

C. When the building is in heating mode and the main hot water pumps are enabled, the radiant floor circulator pump is energized. When heating mode is disabled, the circulator is de-energized.

D. When the slab or room temperature falls below setpoint (slab 80°F, room 70°F, adjustable) the 3-way mixing valve modulates to maintain the supply temperature, according to the following schedule (adjustable):

Outside Air Temp	Supply Temp
0 degrees F	100 degrees F
40 degrees F	80 degrees F

E. When the slab and room temperature are satisfied, the 3-way valve modulates to maintain a neutral supply temperature (initial set point 70°F).

F. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
1. Circulating pump enable.
2. Radiant panel valve open/close command.
3. Space temperature setpoint.
4. Slab temperature setpoint.
5. Space temperature.
6. Slab temperature.
7. Outdoor temperature.
8. Occupied/unoccupied status.

G. At Contractor’s option, a dedicated controller and room, slab and outdoor sensors by Tekmar (no substitutions) may be used to control the radiant floor. This controller shall include an LCD display of setpoints, temperatures, and functions.

4.13 UNIT HEATERS (UH)

A. Space sensor: Wall-mounted, except where sensor is indicated on the Drawings to be mounted on unit at return air inlet. Setpoint dial with limited range, no thermometer.

B. Setpoint: Provide occupied/unoccupied control. Initial setpoints (adjustable):
   1. Unit heaters in mechanical rooms and other unoccupied spaces: 60°F occupied/55°F unoccupied.
   2. Unit heaters in potentially occupied spaces such as Tool Room storage rooms: 68°F occupied/60°F unoccupied.

C. 2-position 2-way control valve cycles on demand from space sensor.

D. Fan cycles on demand from space sensor. Provide strap-on aquastat (location: on return piping unless otherwise detailed) set at 100°F (adjustable) to prevent fan operation when hot water is not available.

E. Mount strap-on aquastat in orientation to be most readily visible from the floor. Insulate over the sensor bulb.

F. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
   1. Space temperature.
   2. Unit on/off command.

4.14 FIRE ALARM SYSTEM SHUT-DOWN INTERFACE

A. For starters that are associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the starter enclosure to interface with the building(s fire alarm system. Upon receipt of a signal from the building(s fire alarm system, power to load side of the starter is turned off. Circuitry is provided to ensure that power is off whether the starter is in the “AUTO”, “HAND” or “BYPASS” mode. If this feature is not available from the starter manufacturer, provide a contactor on the line side of the starter to accomplish the same function. The contactor shall meet the requirements of Division 26.

B. Every fan or air-moving system serving ducts which have fire dampers or fire/smoke dampers shall shut down upon a fire alarm condition.

4.15 RE-START PHASING AFTER POWER INTERRUPTION

A. Upon a power interruption, a loss of power, or at morning start-up, equipment of electrical power greater than or equal to 1.0 HP is started in a staged manner which allows a time delay of 30 seconds between the start of each device.

4.16 SEPTIC PUMP INTERFACE

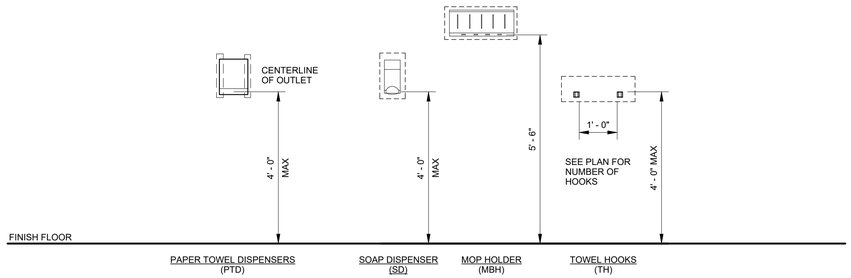
A. Provide septic pump float switch per pump and high limit float switch per pump to provide a high level alarm when level rises above each pump high limit. Provide

interconnecting wiring as required. Coordinate with manufacturer of float switches.

B. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal, for each pump:

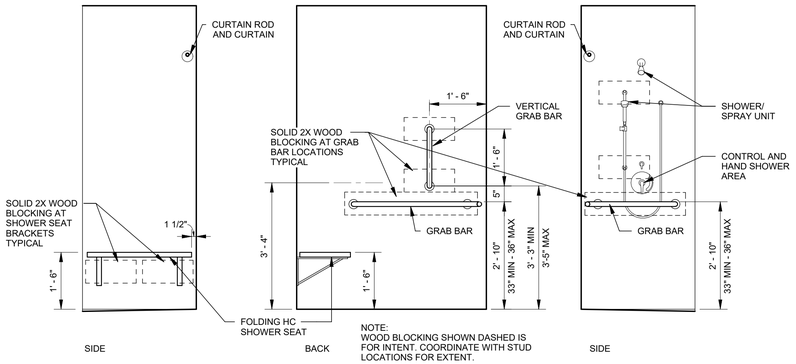
1. High level alarm.

END OF SECTION 230900



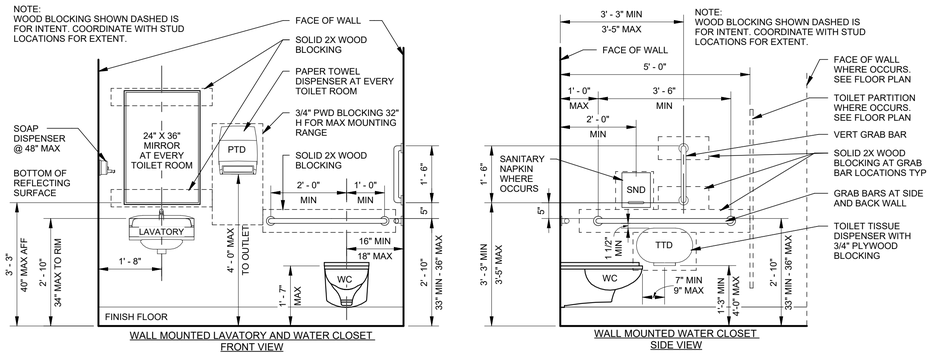
C1 DISPENSER AND ACCESSORY MOUNTING HEIGHTS

SCALE: 1/2" = 1'-0"



B1 TYPICAL SHOWER ACCESSORY AND MOUNTING HEIGHTS

SCALE: 1/2" = 1'-0"



A1 TOILET ACCESSORY MOUNTING DETAIL

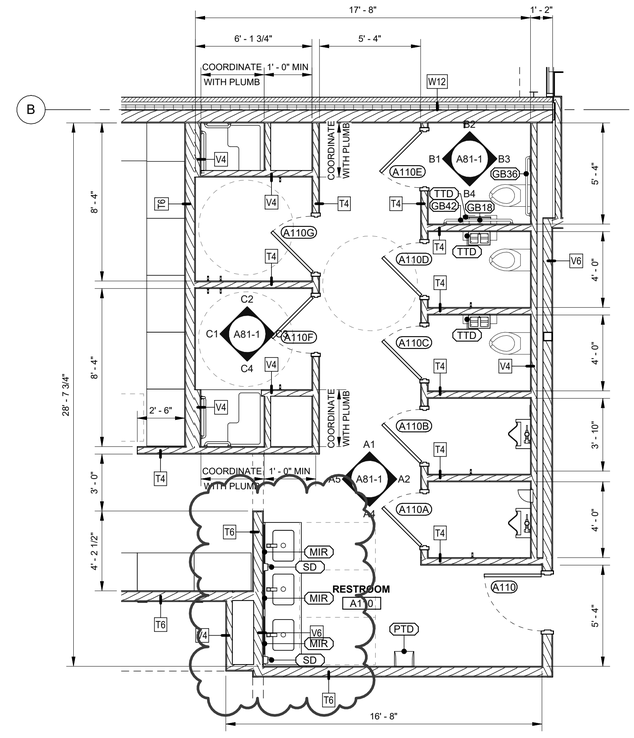
SCALE: 1/2" = 1'-0"

GENERAL NOTES

1. SEE DRAWING A40-1 FOR PARTITION TYPES.
2. SEE STANDARD MOUNTING DETAILS FOR TYPICAL TOILET AND SHOWER ACCESSORY MOUNTING HEIGHTS.
3. GC TO PROVIDE SOLID BLOCKING IN STUD WALLS FOR MOUNTING OF ALL OWNER AND GC PROVIDED ACCESSORIES.
4. DIMENSIONS LOCATING INTERIOR PARTITIONS ARE TO FACE OF GPDW UNLESS NOTED OTHERWISE.
5. REFERENCE PLUMBING DRAWINGS FOR PLUMBING FIXTURE DESIGNATION TYPES, MOUNTING HEIGHTS, AND LOCATIONS.
6. REFERENCE A4/A80-1 FOR SHOWER TRANSITION DETAIL

SYMBOLS LEGEND

- WATER CLOSET
- URINAL
- LAVATORY
- PAPER TOWEL DISPENSER (PTD) (OWNER FURNISHED GC INSTALLED)
- GRAB BARS (GB42) (GB36) (GB18)
- TOILET TISSUE DISPENSER (TTD) (OWNER FURNISHED GC INSTALLED)
- MIRROR (MIR)
- SOAP DISPENSER (SD) (OWNER FURNISHED GC INSTALLED)
- SANITARY NAPKIN DISPOSAL (SND)
- FLOOR DRAINAGE - FD



A3 RESTROOM ENLARGED PLAN

SCALE: 1/4" = 1'-0"

PLAN NORTH TRUE NORTH

Scale: As indicated

No.	Revision	By	Date
1	ADDENDUM 3	MDL	12-4-2025

Designed by: MARK LEE, AIA
ISSUED FOR BID

LICENSED ARCHITECT MARK D. LEE #3649 STATE OF MAINE

	By	Date		By	Date
Designed:	MDL	10-14-2025	Checked:	MDL	10-14-2025
Drawn:	JAE	10-14-2025			

Harriman

PROJ.NO: 25116

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

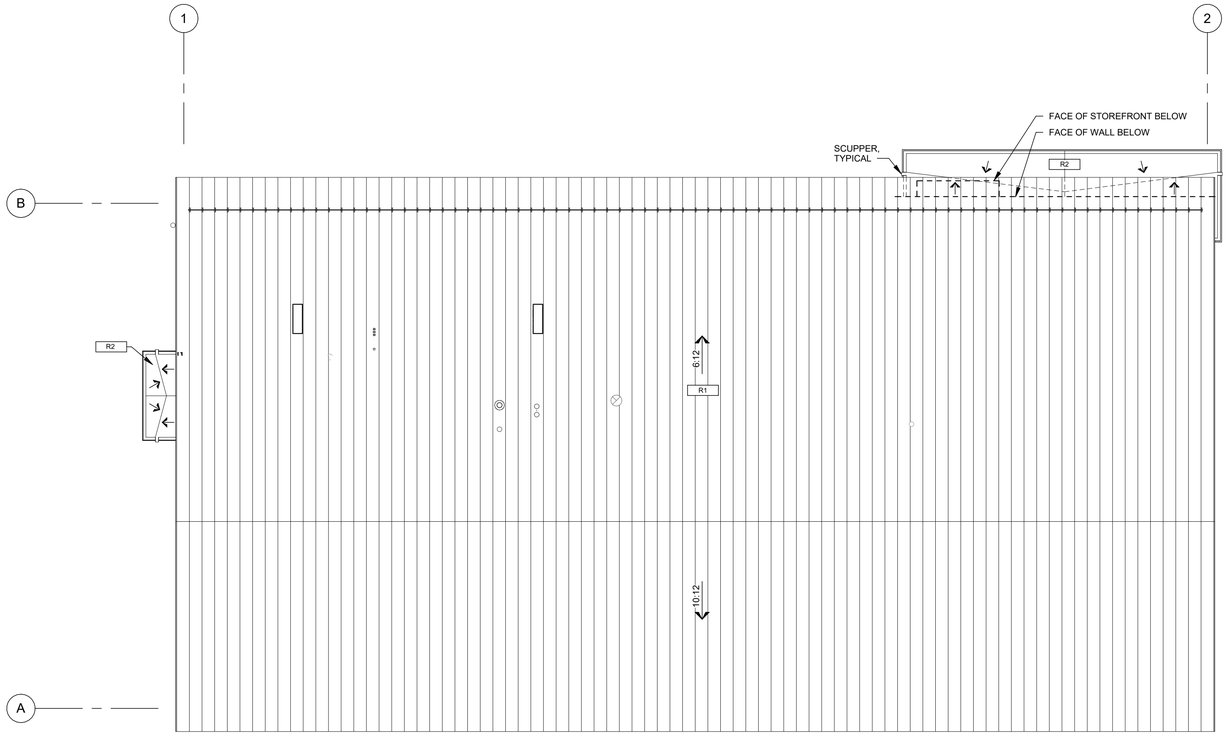
MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
ENLARGED PLANS

SHEET NUMBER: A11-1

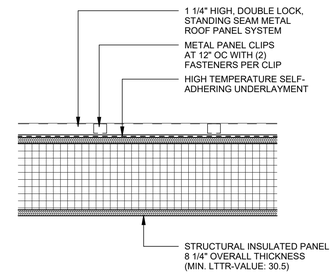
GENERAL NOTES

1. COORDINATE ALL ROOF PENETRATIONS WITH MECHANICAL, PLUMBING, AND ELECTRICAL DRAWINGS.
2. SEE A51 SERIES FOR ROOF DETAILS.



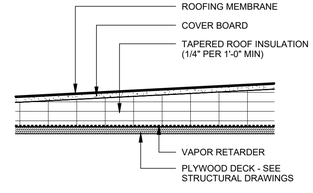
SYMBOLS LEGEND

R1	ROOF TYPE MARKER
←	DIRECTION OF SLOPE
VTR	ROOF VENT SEE DETAIL C1/A50-3
⟷	SNOW GUARD SYSTEM SEE DETAIL B1/A50-1



ROOF SYSTEM - R1

NOTE:
ALL PENETRATIONS THROUGH THE VAPOR RETARDER TO BE SEALED PER MANUFACTURER REQUIREMENTS



ROOF SYSTEM - R2
(AT FLAT LOCATIONS)

ROOF SYSTEM R-VALUE: **R31.6**

R1	STANDING SEAM METAL ROOFING ON COMP INSUL
R2	EPDM ROOFING SYSTEM

A1 ROOF PLAN
SCALE: 1/8" = 1'-0"

PLAN NORTH TRUE NORTH

Scale: As indicated

No.	Revision	By	Date
1	ADDENDUM 3	MDL	12-4-2025

Designed by:

MARK LEE, AIA
ISSUED FOR BID

LICENSED ARCHITECT MARK D. LEE #3649 STATE OF MAINE

	By	Date		By	Date
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Drawn:	JAE	10-14-2025			

PROJ.NO: 25116

Harriman

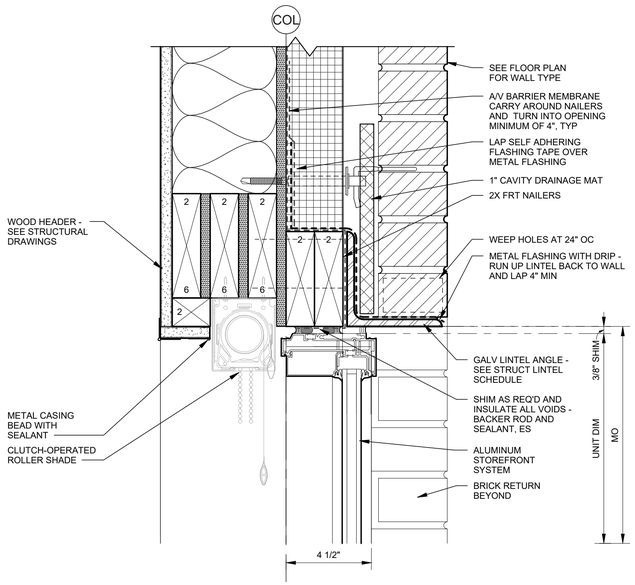
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

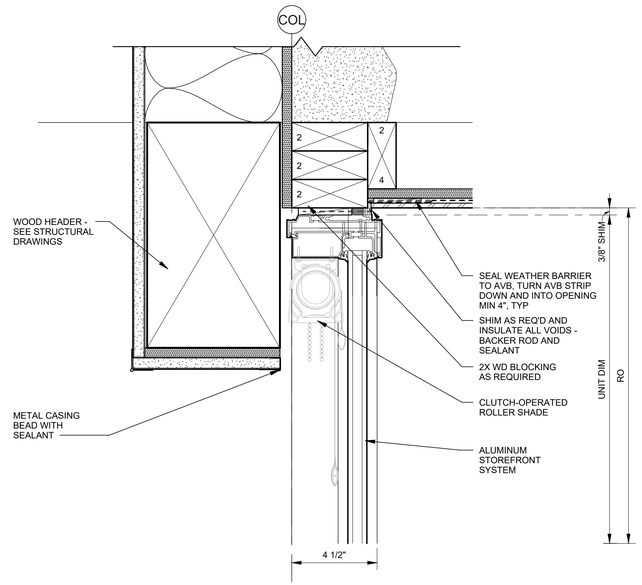
CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
ROOF PLAN

SHEET NUMBER: A15-1



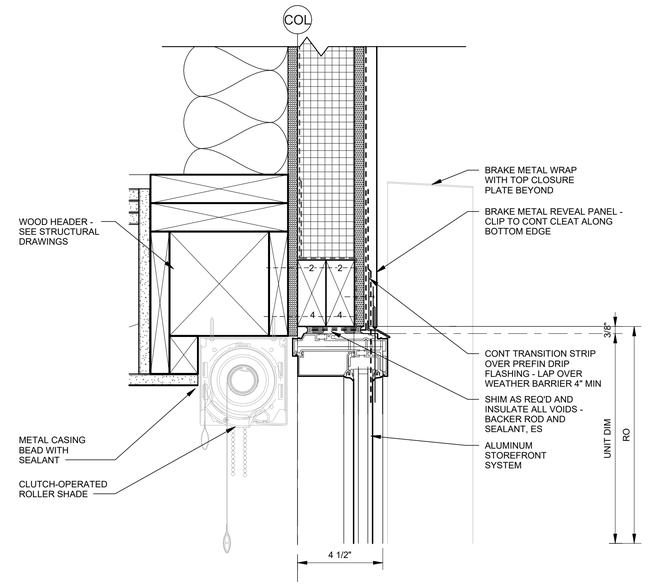
B1 HEAD DETAIL AT BRICK

SCALE: 3" = 1'-0"



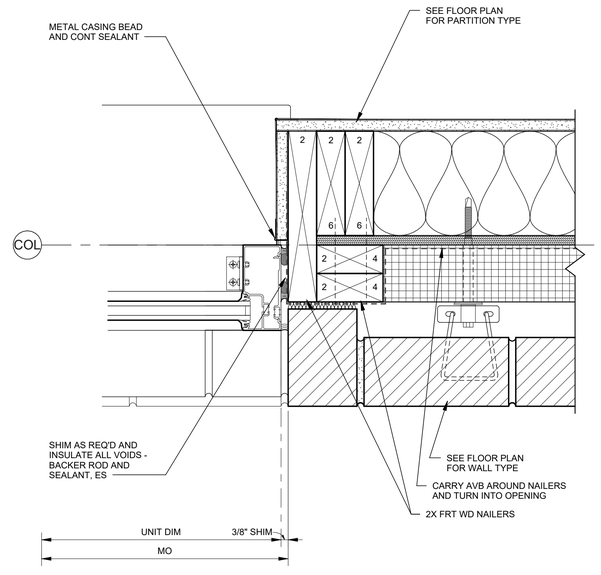
B2 HEAD DETAIL AT CANOPY

SCALE: 3" = 1'-0"



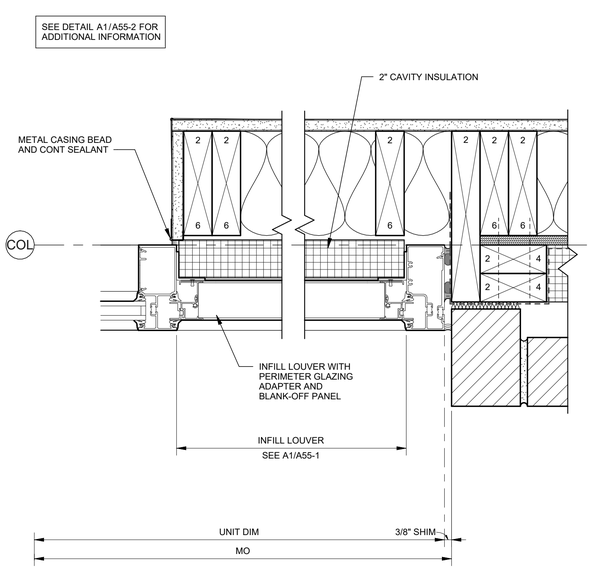
B3 HEAD DETAIL AT BRAKE METAL

SCALE: 3" = 1'-0"



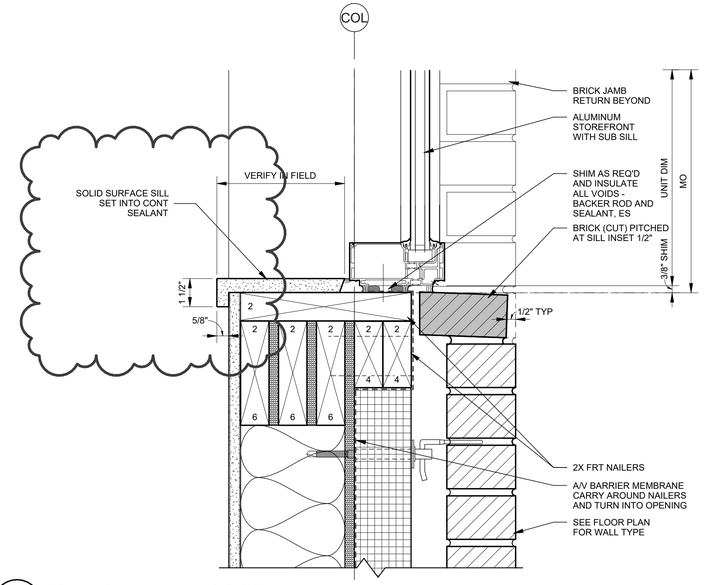
A1 JAMB DETAIL AT BRICK

SCALE: 3" = 1'-0"



A2 JAMB DETAIL AT INFILL LOUVER

SCALE: 3" = 1'-0"



A3 SILL DETAIL AT BRICK

SCALE: 3" = 1'-0"

Scale:

3" = 1'-0"

No.	Revision	By	Date
1	ADDENDUM 3	MDL	12-4-2025

Designed by:

MARK LEE, AIA
ISSUED FOR BID

LICENSED ARCHITECT — MARK D LEE #3649 — STATE OF MAINE

	By	Date		By	Date
Designed:	MDL	10-14-2025	Checked:	MDL	10-14-2025
Drawn:	JAE	10-14-2025			

Harriman

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

PROJ.NO: 25116

MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
STOREFRONT DETAILS

SHEET NUMBER: A55-2

ROOM FINISH SCHEDULE

ROOM		FLOOR	BASE	WAIN SCOT	WALLS				REMARKS
No.	NAME			CODE	N	E	S	W	
T.O.CONC.									
A101	VESTIBULE	WOM1	RWB1	-	P1	P1	P1	P1	
A102	CORRIDOR	SC	RWB1	-	P1	P1	P1	P1	
A103	CREW LEADER	SC	RWB1	-	P1	P1	P1	P1	
A104	CONFERENCE	SC	RWB1	-	P3	P3	P3	P3	
A105	COMM	SC	RWB1	-	P1	P1	P1	P1	
A106	ASSISTANT CREW LEADER	SC	RWB1	-	P1	P1	P1	P1	
A107	CREW OFFICE	SC	RWB1	-	P1	P1	P1	P1	
A108	FLEX OFFICE	SC	RWB1	-	P1	P1	P1	P1	
A109	FLEX OFFICE	SC	RWB1	-	P1	P1	P1	P1	
A110	RESTROOM	SC	PT2	PT2	PT2/P1	PT2/P1	PT2/P1	PT2/P1	REFER TO INTERIOR ELEVATIONS FOR PAINT AND WAINSCOT DESIGNATIONS. WAINSCOT FULL HEIGHT AT WET WALLS, WAINSCOT AT 5'-0" ON WALLS ADJACENT TO WET WALLS
A111	LOCKER	SC	RWB1	-	P1	P1	P1	P1	
A112	CREW ROOM	SC	RWB1	-	P3	P3	P3	P3	REFER TO ELEVATIONS D1 AND D3 FOR WALL FINISH MATERIALS, PATTERNS AND LOCATIONS
A113	STORAGE	SC	RWB1	-	P1	P1	P1	P1	
A114	BUILDING SERVICES	SC	RWB1	-	P1	P1	P1	P1	
A115	UTILITY VESTIBULE	SC/WOM1	RWB1	-	P1	P1	P1	P1	REFER TO MATERIALS PLAN FOR EXTENT OF FLOOR FINISHES
ATTIC									
A201	ATTIC	-	-	-	P1	P1	P1	P1	

MATERIALS LEGEND

MATERIAL	CODE No.	MANUFACTURER / SERIES	COLOR / FINISH
STONE THRESHOLD		SEE TILE SPECIFICATION	
SEALED CONCRETE	SC	SEE SPECIFICATION	POLISHED CONCRETE
CERAMIC WALL TILE 8" X 24"	CT1	DALTILE COLOR WHEEL LINEAR	MATTE SUEDE GRAY (0782)
CERAMIC WALL TILE 8" X 24"	CT2	DALTILE COLOR WHEEL LINEAR	MUSTARD (1012)
PORCELAIN FLOOR TILE 12" x 12"	PT1	DALTILE/ VOLUME 1.0	VL73 STEREO GREY / MATTE
PORCELAIN WALL TILE 12" X 24"	PT2	DALTILE/ VOLUME 1.0	VL64 TRUFFLE / MATTE
RESILIENT WALL BASE - 6"	RWB1	MANNINGTON COMMERCIAL / BURKEBASE /TYPE TP	JACKALOPE 190
WALK OF MAT TILE 18" X 36"	WOM1	MANNINGTON COMMERCIAL / FRIXTION / CHARGE	STATIC 34365
PAINT - FIELD COLOR	P1	SHERWIN WILLIAMS	OYSTER WHITE (SW7637)
PAINT - TRIM/DOORS	P2	SHERWIN WILLIAMS	INTELLECTUAL GRAY (SW7017)
PAINT - ACCENT	P3	SHERWIN WILLIAMS	MOODY BLUE (SW6221)
SOLID SURFACE	SS1	CORIAN	DOMINO TERAZZO
PLASTIC LAMINATE	PL1	PIONITE MODERN MATTE	GULF STREAM (SB060)

Scale:

No.	Revision	By	Date
1	ADDENDUM 3	MDL	12-4-2025

Designed by:

MARK LEE, AIA
ISSUED FOR BID

LICENSED ARCHITECT MARK D. LEE #3640 STATE OF MAINE

	By	Date		By	Date
Designed:	MDL	10-14-2025	Checked:	MDL	10-14-2025
Drawn:	JAE	10-14-2025			

Harriman

PROJ.NO: 25116

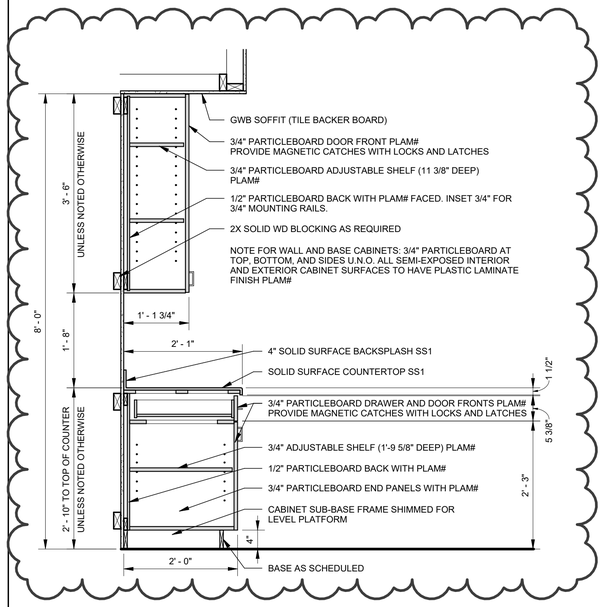
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

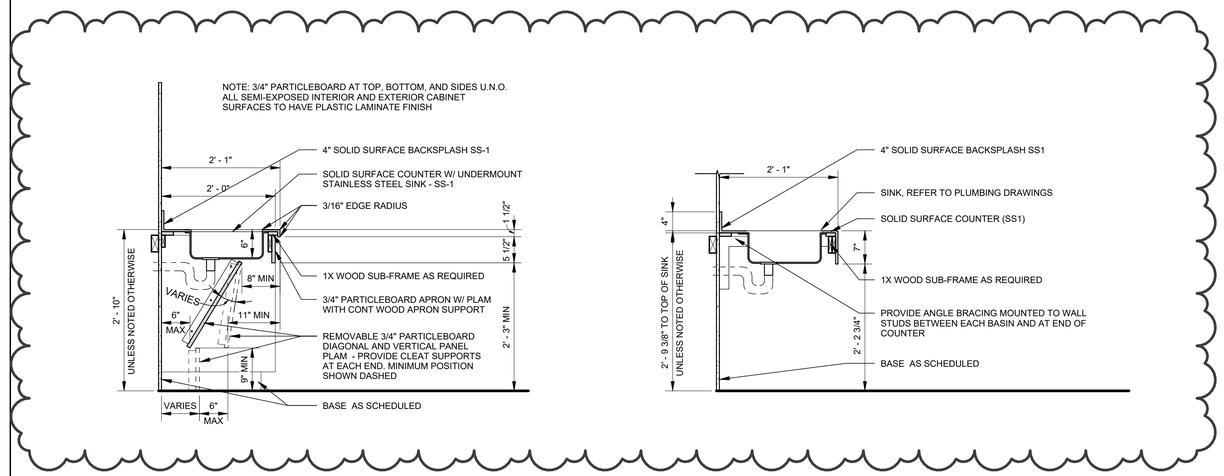
CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
ROOM FINISH SCHEDULE

SHEET NUMBER: A61-1



B1 WALL AND BASE CABINET DETAIL - SS

SCALE: 3/4" = 1'-0"



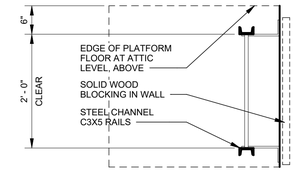
A1 24" DEEP SINK BASE (ADA)

SCALE: 3/4" = 1'-0"

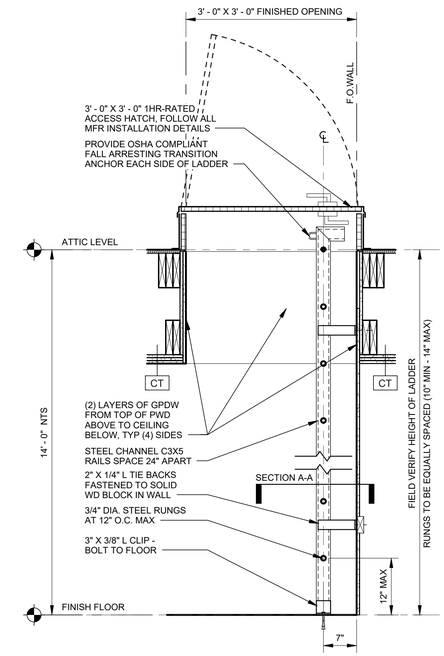
A2 24" DEEP HANDICAP SINK BASE (ADA)- SS

SCALE: 3/4" = 1'-0"

NOTES:
1. WELD AND GRIND SMOOTH ALL JOINTS - ALL COMPONENTS TO BE PAINTED P1.
2. SEE STRUCTURAL DRAWINGS FOR FRAMING AT OPENING.



SECTION A-A



A5 ACCESS LADDER DETAIL

SCALE: 3/4" = 1'-0"

Scale: 3/4" = 1'-0"

No.	Revision	By	Date
1	ADDENDUM 3	MDL	12-4-2025

Designed by: MARK LEE, AIA
ISSUED FOR BID

LICENSED ARCHITECT MARK D. LEE #3840 STATE OF MAINE

	By	Date		By	Date
Designed:	MDL	10-14-2025	Checked:	MDL	10-14-2025
Drawn:	JAE	10-14-2025			

PROJ.NO: 25116

Harriman

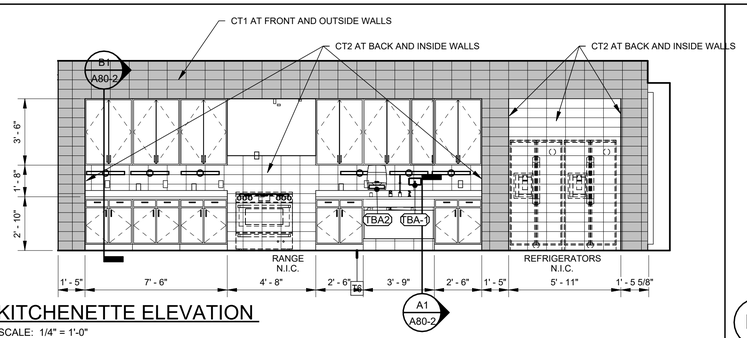
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

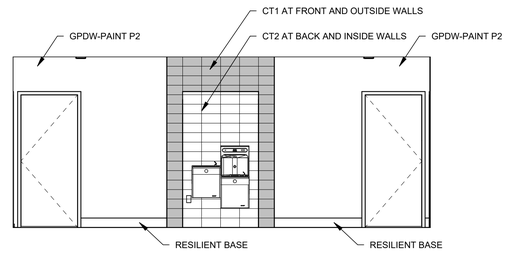
MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
STANDARD INTERIOR DETAILS

SHEET NUMBER: A80-2



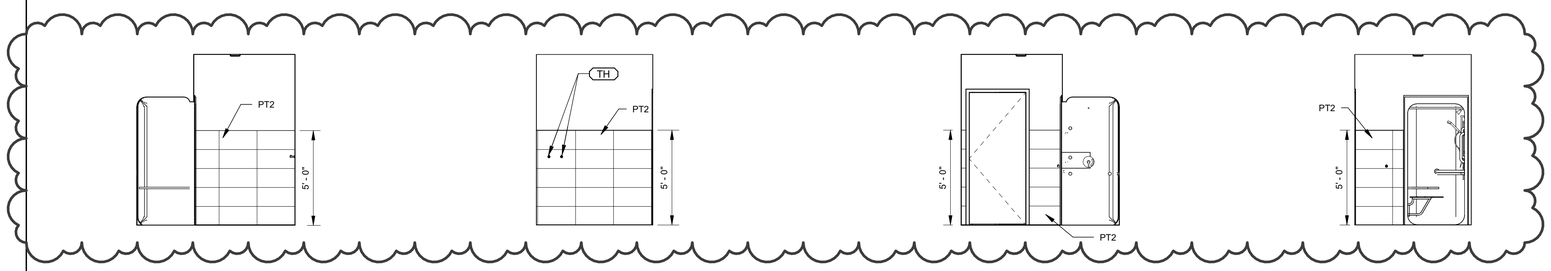
D1 KITCHENETTE ELEVATION
SCALE: 1/4" = 1'-0"



D3 CORRIDOR ELEVATION
SCALE: 1/4" = 1'-0"

GENERAL NOTES

1. PAPER TOWEL DISPENSER AND SOAP DISPENSER PROVIDED BY OWNER, INSTALLED BY G.C.
2. PROVIDE BLOCKING IN WALL AS NEEDED FOR ALL TOILET AND BATH ACCESORIES

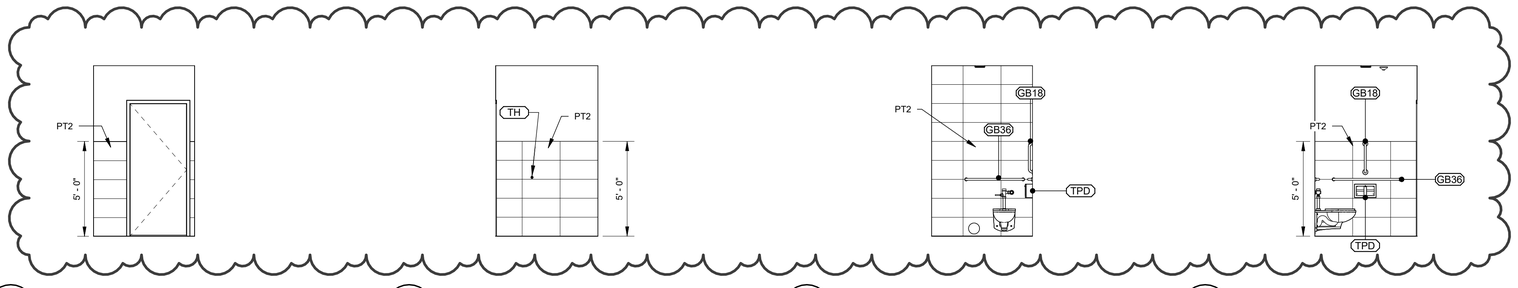


C1 SHOWER WEST
SCALE: 1/4" = 1'-0"

C2 SHOWER NORTH
SCALE: 1/4" = 1'-0"

C3 SHOWER EAST
SCALE: 1/4" = 1'-0"

C4 SHOWER SOUTH
SCALE: 1/4" = 1'-0"

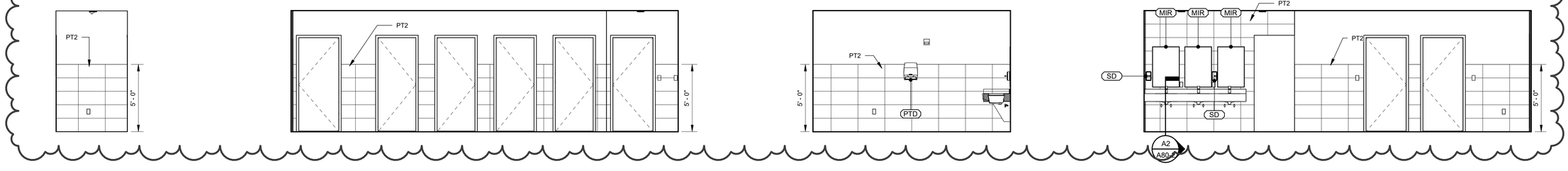


B1 TOILET WEST
SCALE: 1/4" = 1'-0"

B2 TOILET NORTH
SCALE: 1/4" = 1'-0"

B3 TOILET EAST
SCALE: 1/4" = 1'-0"

B4 TOILET SOUTH
SCALE: 1/4" = 1'-0"



A1 A110 - NORTH ELEVATION
SCALE: 1/4" = 1'-0"

A2 A110 - EAST ELEVATION
SCALE: 1/4" = 1'-0"

A4 A110 - SOUTH ELEVATION
SCALE: 1/4" = 1'-0"

A5 A110 - WEST ELEVATION
SCALE: 1/4" = 1'-0"

Scale:
As indicated

No.	Revision	By	Date
1	ADDENDUM 3	MDL	12-4-2025

Designed by:
MARK LEE, AIA
ISSUED FOR BID

LICENSED ARCHITECT
MARK D. LEE #3649
STATE OF MAINE

	By	Date		By	Date
Designed:	MDL	10-14-2025	Checked:	MDL	10-14-2025
Drawn:	JAE	10-14-2025			

PROJ.NO: 25116

Harriman

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
INTERIOR ELEVATIONS AND DETAILS

SHEET NUMBER: A81-1

PUMP SCHEDULE

TAG	MANUFACTURER	MODEL	SERVICE	FLOW (GPM)	HEAD (FT.WG)	EFF'Y (%)	SUCTION FLANGE (IN)	DISCHARGE FLANGE (IN)	MOTOR CONTROL	RPM	ELECTRICAL			NOTES
											POWER (WATTS)	VOLTAGE	PHASE	
P-1	GRUNDFOS	MAGNA3 50-180	BOILER	30	38	36.4	2	2	VFD	4680	794	115	1	

LOUVER SCHEDULE

TAG	MANUFACTURER	MODEL	AIR FLOW (CFM)	MIN. FREE AREA (SQ.FT)	APD (IN.WG)	VELOCITY (FPM)	NOTES
L-1	GREENHECK	ESD-403	4200	16.5	0.1	255	
L-2	GREENHECK	ESD-403	4200	6.25	0.1	672	

LOUVER OVERALL DIMENSIONS - COORDINATE WITH ARCHITECTURAL DRAWINGS.
PERFORMANCE SCHEDULED ABOVE IS FOR ACTIVE PORTION OF LOUVER. BLANK OFF AND INSULATE INACTIVE PORTIONS OF LOUVER.

GAS BOILER SCHEDULE

TAG	MANUFACTURER	MODEL	SERVICE	FUEL TYPE	INPUT (MBH)	OUTPUT (MBH)	FLOW (GPM)	ELECTRICAL			NOTES
								POWER (HP)	VOLTAGE	PHASE	
B-1	WEIL MCLAIN	EVERGREEN PRO 220	A114 - BUILDING SERVICES	LP	220	179	20	120	120	1	

RADIANT MANIFOLD SCHEDULE

TAG	MANUFACTURER	ROOM NUMBER	BTU/SQ.FT	AREA (SQ.FT)	CAPACITY (BTU)	FLOW (GPM)	WPD (FT.WG)	FLOOR MATERIAL	DIMENSIONS			NOTES
									WIDTH (IN)	LENGTH (IN)	HEIGHT (IN)	
RFM-1	WATTS	SEE PLANS	20	1921	38420	4.4	2.9	POLISHED CONCRETE	4-1/2	40	29-1/2	
RFM-2	WATTS	SEE PLANS	20	1850	37000	4.3	2.7	POLISHED CONCRETE	4-1/2	24	29-1/2	
RFM-3	WATTS	SEE PLANS	20	1160	23200	2.7	2.6	POLISHED CONCRETE	4-1/2	24	29-1/2	
RFM-4	WATTS	SEE PLANS	20	720	14400	1.7	1.5	POLISHED CONCRETE	4-1/2	24	29-1/2	

MANIFOLD COVERS SHALL BE FACTORY PAINTED WHITE.

REGISTERS, GRILLES & DIFFUSERS SCHEDULE

TAG	MANUFACTURER	MODEL	INLET SIZE SQUARE		DAMPER	MAX NOICE CRITERIA (NC)	MAX STATIC PRESSURE (IN-WG)	FINISH	NOTES
			LENGTH (IN)	WIDTH (IN)					
E1	PRICE INDUSTRIES	80	6	6	NO	25	0.13	WHITE ENAMEL	
E2	PRICE INDUSTRIES	80	8	8	NO	25	0.13	WHITE ENAMEL	
R1	PRICE INDUSTRIES	80	6	6	NO	25	0.13	WHITE ENAMEL	
R2	PRICE INDUSTRIES	80	10	10	NO	25	0.1	WHITE ENAMEL	
R3	PRICE INDUSTRIES	80	12	12	NO	25	0.1	WHITE ENAMEL	
R4	PRICE INDUSTRIES	80	14	14	NO	25	0.1	WHITE ENAMEL	
S1	PRICE INDUSTRIES	SMD	6	6	NO	25	0.1	WHITE ENAMEL	
S2	PRICE INDUSTRIES	SMD	9	9	NO	25	0.1	WHITE ENAMEL	

AIR SEPARATOR SCHEDULE

TAG	MANUFACTURER	MODEL	SERVICE	FLOW (GPM)	PIPE SIZE (IN)	WPD (FT.WG)	DIMENSIONS		NOTES
							DIAMETER (IN)	HEIGHT (IN)	
AS-1	TACO	4902A-125	BOILER	30	2	5	10	16.5	

DUCTLESS AIR CONDITIONER SCHEDULE

TAG	MANUFACTURER	MODEL	TYPE	AIRFLOW		NOMINAL COOLING (TONS)	MAXIMUM COOLING CAPACITY	MINIMUM COOLING CAPACITY	MINIMUM AMBIENT	LIQUID	SUCTION	REFRIGERANT	ELECTRIC		
				MAX	MIN								VOLTS	PHASE	MCA
DAC-1A	TRANE	PUY-AK12NL		1590	0	1	12,200	4,300	-40 °F	1/4"	1/2"		208 V	1	16.0
DAC-1B	TRANE	PKA-AL12NL	Wall Mounted Unit	375	215	1	12,200	4,300	-40 °F	1/4"	1/2"	R454B	208 V	1	

Scale:

No.	Revision	By	Date
1	ADDENDUM 3	ERD	12-04-2025

Designed by:

DAVID STORY, P.E.
ISSUED FOR BID

STATE OF MAINE · DAVID W. STORY · NO. 12653 · LICENSED PROFESSIONAL ENGINEER

	By	Date		By	Date
Designed:	MSJ	10-14-2025	Checked:	MSJ	10-14-2025
Drawn:	ERD	10-14-2025			

PROJ.NO: 25116

Harriman

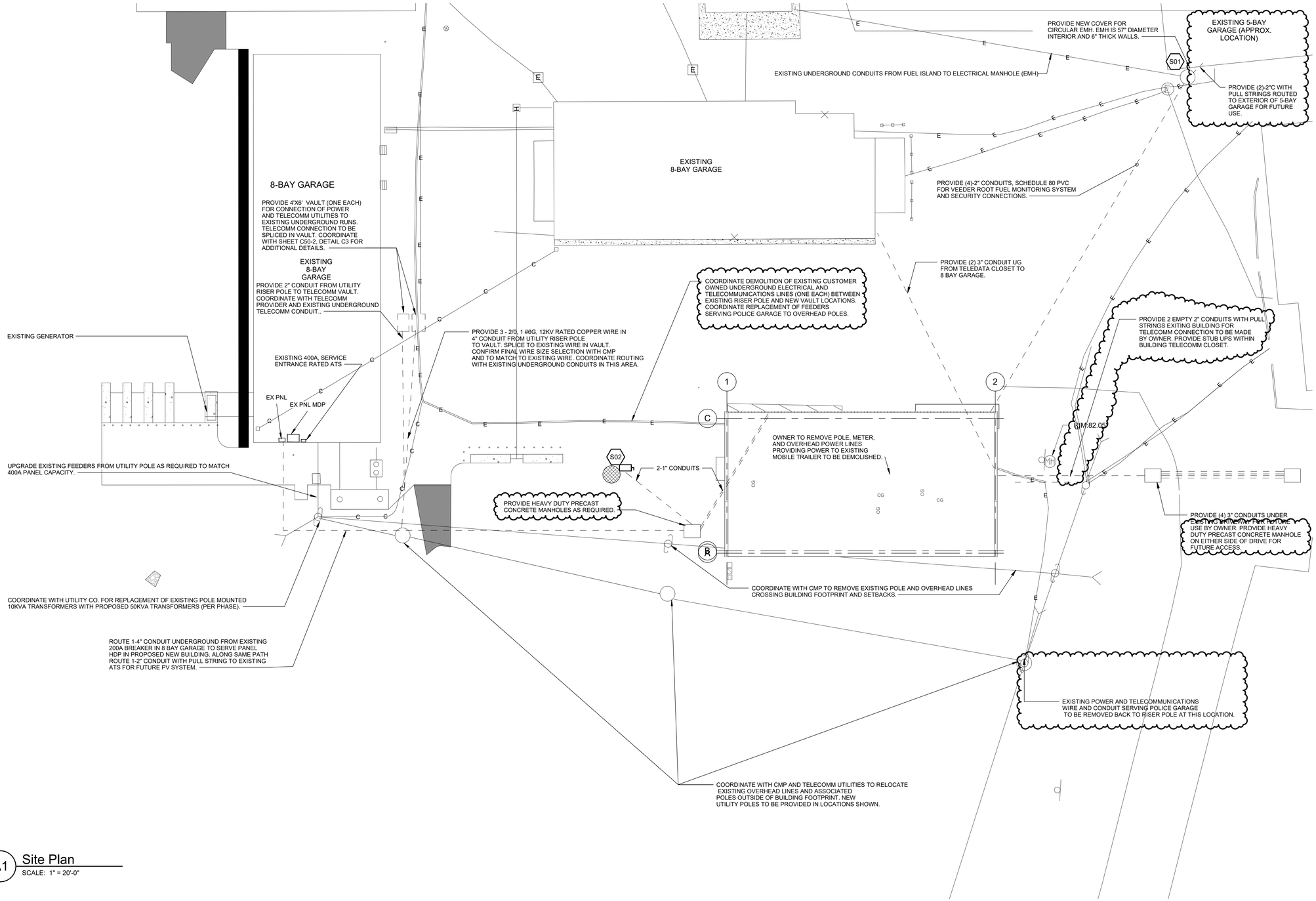
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
SCHEDULES

SHEET NUMBER: M60-2



A1 Site Plan
SCALE: 1" = 20'-0"

GENERAL NOTES

1 ALL LIGHTING AND POWER CONDUCTORS SHALL BE INSTALLED BETWEEN 30" (MINIMUM) BELOW FINISHED GRADE.
2 ALL COMMUNICATIONS CONDUIT AND CABLES SHALL BE INSTALLED 30" (MINIMUM) BELOW FINISHED GRADE.
3 ALL CONDUCTORS FOR EXTERIOR LIGHTING AND POWER CIRCUITS SHALL BE #10 AWG MINIMUM.
4 PROVIDE DIRECT BURIED SCHEDULE 80 PVC FOR ALL UNDERGROUND CONDUIT RUNS.
5 COORDINATE TRENCH CUTS AND PAVING LIMITS WITH DIVISION 32.

KEY NOTES

S01 CONNECTION OF VEEDER ROOT SYSTEM AT FUEL ISLAND LOCATION TO PROPOSED MAINTENANCE BUILDING WILL BE PROVIDED AND TERMINATED IN CREW LEADER OFFICE A103 BY OWNER. PROVIDE PULL STRING IN NEW CONDUIT RUN.

S02 PROVIDE DISCONNECT FOR SITE SUMP PUMP. TIE TO CIRCUIT 48,50 IN PANEL HDP. SEE PANEL SCHEDULE FOR WIRE SIZE. PROVIDE ADDITIONAL CONDUIT FOR TELE DATA AS REQUIRED FOR BAS CONNECTION. COORDINATE FINAL CONNECTION REQUIREMENTS WITH DIV 670 AND INSTALLER.

Scale: 1" = 20'-0"

No.	Revision	By	Date
1	ADDENDUM 3		12-04-2025

Designed by: CHELSEA HADSEL, P.E.
ISSUED FOR BID

STATE OF MAINE — CHELSEA L. HADSEL No. 17097 — LICENSED PROFESSIONAL ENGINEER

	By	Date		By	Date
Designed:	CLH	10-14-2025	Checked:	CLH	10-14-2025
Drawn:	CLH	10-14-2025			

Harriman

PROJ.NO: 25116

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

MTA PROJECT MANAGER: **Brian A. Taddeo, P.E.**

CONTRACT 2026.07
CROSBY MAINTENANCE OFFICE BUILDING
SITE PLAN

SHEET NUMBER: E80-1
88 OF 88