

MAINE TURNPIKE AUTHORITY

MAINE TURNPIKE

CONTRACT DOCUMENTS

CONTRACT 2026.08

KENNEBUNK MAINTENANCE FIRE PROTECTION MITIGATION

MILE 25.3

NOTICE TO CONTRACTORS

PROPOSAL

CONTRACT AGREEMENT

CONTRACT BOND

FINAL LIEN AND CLAIM WAIVER AND AFFIDAVIT

SPECIFICATIONS

MAINE TURNPIKE AUTHORITY
SPECIFICATIONS

The Specifications are divided into two parts:
Part I, Supplemental Specifications and Part II, Special
Provisions.

The Maine Turnpike Supplemental Specifications are additions
and alterations to the March 2020 Maine Department of
Transportation Standard Specifications. See Subsection 100.1.

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MAINE TURNPIKE AUTHORITY

NOTICE TO CONTRACTORS

Sealed Proposals will be received by the Maine Turnpike Authority for:

CONTRACT 2026.08

KENNEBUNK MAINTENANCE FIRE PROTECTION MITIGATION

MILE 25.3

at the office of the Maine Turnpike Authority, 2360 Congress Street, Portland, ME, until 11:00 a.m., prevailing time as determined by the Authority on May 21, 2026 at which time and place the Proposals will be publicly opened and read. Bids will be accepted from Contractors **prequalified** by the Maine Department of Transportation for Building Construction Projects. All other bids may be rejected. This Project includes a wage determination developed by the State of Maine Department of Labor. **We now accept electronic bids for bid packages posted on the Bid Express [website](#). Electronic bids do not have to be accompanied by paper bids. Until further notice, dual bids (one paper, one electronic) will be accepted, with the paper copy taking precedence.**

The work consists of the following:

1. Installation of a fire protection (sprinklers) and alarm monitoring system in the Eight Bay (North and South) and Ten Bay Garages.
2. Addition of fire water service, via new water main, to each building (Eight Bay North and South and Ten Bay Garages) from the existing water main line on the property and associated site work, including paving removal, trenching, repaving, etc.
3. Modifications to the existing sprinkler system and removing windows and in-filling with CMU in divider wall in the Ten Bay (Office/Maintenance) Garage and adjoining Four Bay (Storage) Garage.
4. Electrical system replacement to the Eight Bay (North & South) Garages. Note – the upgrade only pertains to the original portion of the building and not the 2018 addition.
5. Restroom renovation in the Eight Bay North Garage.
6. Addition of access ladder to the attic's access hatches in the Eight Bay (North & South) Garages.
7. Replace the two-man doors with wiring to junction boxes for addition of access controls in the Eight Bay (North & South) and 10 Bay Garages. Note: the addition of the access controls is by others.
8. All other work incidental thereto in accordance with the Plans and Specifications.

Plans and Contract Documents may be examined by prospective Bidders weekdays between 8:00 a.m. and 4:30 p.m. at the office of the Maine Turnpike Authority, 2360 Congress Street, Portland, Maine. **The Half Size Plans** and Contract Documents may be obtained from the Authority

upon payment of One Hundred Fifty (\$100.00) Dollars for each set, which payment will not be returned. Checks shall be made payable to: Maine Turnpike Authority. The Plans and Contract Documents may also be downloaded from a link on our website at <http://www.mainturnpike.com/project-and-planning/Construction-Contracts.aspx>.

For general information regarding Bidding and Contracting procedures, contact:

Nate Carll, Purchasing Manager
Maine Turnpike Authority
2360 Congress Street, Portland, ME. 04102
Phone: (207) 482-8115; Email: ncarll@mainturnpike.com

For information regarding Schedule of Items, plan holders list and bid results, visit our website at <http://www.mainturnpike.com/project-and-planning/Construction-Contracts.aspx> . For Project specific information, email all questions to Nate Carll, Purchasing Manager, ncarll@mainturnpike.com. Responses will not be prepared for questions received by telephone. Bidders shall not contact any other Authority staff or Consultants for clarification of Contract provisions, and the Authority will not be responsible for any interpretations so obtained.

For general information regarding Bidding and Contracting procedures, contact Nate Carll, Purchasing Manager, at (207) 482-8115. For information regarding Schedule of Items, plan holders list and bid results, visit our website at the link below. To submit questions, use the electronic Request For Information (RFI) tab at <https://www.mainturnpike.com/projects/construction-contracts> for Contract 2026.08. **Questions shall be submitted by May 13, 2026 at 5:00pm.** Responses will not be prepared for questions received by telephone. Bidders shall not contact any other Authority staff or Consultants for clarification of Contract provisions, and the Authority will not be responsible for any interpretations so obtained.

All work shall be governed by the Specifications entitled "State of Maine, Department of Transportation, Standard Specifications, Revision of November 2014", "Standard Details, Revision of November 2020" and "Best Management Practices for Erosion and Sediment Control", latest issue. Copies and recent updates to these publications can be downloaded at: <http://www.maine.gov/mdot/contractors/publications/> .

Proposals must be accompanied by an original bid bond, certified or cashier's check payable to the Maine Turnpike Authority in an amount not less than Five (5%) Percent of the Total Amount in the Proposal, but not less than \$500.00. The Bidder to whom a Contract is awarded will be required to furnish a Surety Corporation Bond, satisfactory to the Authority, on the standard Contract Bond form of the Authority, for a sum not less than the Total Amount of the Proposal.

Proposals must be made upon the Proposal Forms furnished by the Authority separately with the Contract Documents, and must be enclosed in the sealed special addressed envelope provided therefore bearing the name and address of the Bidder, the name of the Contract, and the date and time of Proposal opening on the outside.

A pre-bid conference will be held on May 5, 2026 at 11:00 a.m. at the Maine Turnpike Authority, 150 Fletcher Street, Kennebunk, Maine.

The Authority reserves the unqualified right to reject any or all Proposals and to accept that Proposal which in its sole judgment will under all circumstances serve its best interest.

Very Truly Yours,
MAINE TURNPIKE AUTHORITY

Nate Carll
Purchasing Manager
Maine Turnpike Authority

Maine Turnpike Authority

MAINE TURNPIKE

PROPOSAL

CONTRACT 2026.08

KENNEBUNK MAINTENANCE FIRE PROTECTION MITIGATION

MILE 25.3

MAINE TURNPIKE AUTHORITY

PROPOSAL

CONTRACT 2026.08

KENNEBUNK MAINTENANCE FIRE PROTECTION MITIGATION

MILE 25.3

TO MAINE TURNPIKE AUTHORITY:

The work consists of the following:

1. Installation of a fire protection (sprinklers) and alarm monitoring system at the Eight Bay (North and South) Garages and Ten Bay Garage.
2. Addition of fire water services via new water main to each building (Eight Bay North and South Garages and Ten Bay Garage) from the main water line on the property and associated site work, paving removal, trenching, repaving, etc.
3. Modifications to the existing sprinkler system and removal and infill of two windows in divider wall within the Ten Bay (Office/Maintenance) Garage and adjoining Four Bay (Storage) Garage.
4. Electrical system replacement to the Eight Bay (North & South) Garages. Note – the upgrade only pertains to the original portion of the building and not the 2018 addition.
5. Restroom renovation in the Eight Bay North Garage.
6. Addition of access ladder to the attic's access hatches in the Eight Bay (North & South) Garages.
7. Replace the two-man doors with wiring to junction boxes for installation of access controls in each garage (Eight Bay – North & South and 10 Bay). Note: access controls are by others.
8. All other work incidental thereto in accordance with the Plans and Specifications.

This Work will be done under a Contract known as Contract 2026.08 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. 2026.08**

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
202.203	Pavement Butt Joints	Square Yard	125				
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				
206.061	Structural Earth Excavation – Drainage & Minor Structures Below Grade	Cubic Yard	100				
304.10	Aggregate Subbase Course (MDOT Type D)	Cubic Yard	440				
304.14	Aggregate Base Course (MDOT Type A)	Cubic Yard	100				
310.23	3" Recycled Asphalt Pavement (Pricing for placement only)	SY	885				
403.207	HMA 12.5mm	TON	130				
CARRIED FORWARD:							

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
409.15	Bituminous Tack Coat RS-1 or RS1h - Applied	GAL	25				
419.30	Sawing Bituminous Pavement	Linear Foot	1,700				
502.56	Structural Concrete	Cubic Yard	5				
615.07	Loam	Cubic Yard	52				
618.13	Seeding Method 1	Unit	5				
619.1202	Temporary Mulch	Lump Sum	1				
626.121	Quazite Junction Box (36x24)	Each	3				
655.2041	Electrical (3" Conduit-1 Way duct bank)	Linear Foot	290				
655.2043	Electrical (3" Conduit-3 Way duct bank)	Linear Foot	2,850				
656.75	Temporary Soil Erosion and Water Pollution Control	Lump Sum	1				
800.701	Fire Protection and Structural Improvements (8 Bay South)	Lump Sum	1				
800.702	Fire Protection and Structural Improvements (8 Bay North)	Lump Sum	1				
800.703	Fire Protection Improvements (10 Bay and adjoining 4 Bay Storage)	Lump Sum	1				
800.704	Fire Protection Improvements (10 Bay)	Lump Sum	1				
CARRIED FORWARD:							

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
BROUGHT FORWARD:						Dollars	Cents
825.461	Water Main (6" HDPE DR 9)	Linear Foot	1,100				
825.601	Water Main (6" DI CL 52)	Linear Foot	50				
825.700	Water Main (Fire Hydrant)	Each	1				
832.41	Type A Steel Site Bollard	Each	6				
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)

MAINE TURNPIKE AUTHORITY

MAINE TURNPIKE

KENNEBUNK MAINTENANCE FIRE PROTECTION MITIGATION

MILE 25.3

CONTRACT AGREEMENT

This Agreement made and entered into between the Maine Turnpike Authority, and sometimes termed the “Authority”, and _____

_____ herein termed the “Contractor”:

WITNESSETH: That the Authority and the Contractor, in consideration of the premises and of the mutual covenants, considerations and agreements herein contained, agree as follows:

FIRST: The parties hereto mutually agree that the documents attached hereto and herein incorporated and made a part hereof collectively evidencing and constituting the entire Contract to the same extent as if herein written in full, are the Notice to Contractors, the Accepted Proposal, the Specifications, the Plans, this Agreement, the Contract Bond and all Addenda to the Contract Documents duly issued and herewith enumerated:

SECOND: The Contractor for and in consideration of certain payments to be made as hereafter specified, hereby covenants and agrees to perform and execute all of the provisions of this Contract and of all documents and parts attached hereto and made a part thereof, and at his own cost and expense to furnish and perform everything necessary and required to construct and complete, ready for its intended purpose, in accordance with the Contract and such instructions as the Engineer may give, acceptable to the Authority, in the times provided, all of the Work covered and included under Contract No. _____ covering _____ as herein described.

THIRD: In consideration of the performance by the Contractor of his covenants and agreements as herein set forth, the Authority hereby covenants and agrees to pay the Contractor according to the Schedule of Prices set forth in the Proposal with additions and deductions as elsewhere herein provided in the times and in the manner stated in the Specifications. This Agreement shall insure to the benefit of, and shall be binding upon the parties hereto, and upon their respective successors and assigns; but neither party hereto shall assign or transfer his interest herein in whole or in part without the consent of the other, except as herein provided.

IN WITNESS WHEREOF the parties to this Agreement have executed the same in quintuplicate.

AUTHORITY -

MAINE TURNPIKE AUTHORITY

By: _____

Title: CHAIRMAN

Date of Signature: _____

ATTEST:

Secretary

CONTRACTOR -

CONTRACTOR

By: _____

Title: _____

Date of Signature: _____

WITNESS:

CONTRACT BOND

KNOW ALL MEN BY THESE PRESENTS that _____
of _____ in the County of _____ and State of _____
as Principal, and _____ a Corporation duly organized under the
laws of the State of _____ and having a usual place of business in _____

As Surety, are held and firmly bound unto the Maine Turnpike Authority in the sum of _____ Dollars (\$_____.____),
to be paid to said Maine Turnpike Authority, or its successors, for which payment, well and truly
to be made, we bind ourselves, our heirs, executors, successors and assigns jointly and severally
by these presents.

The condition of this obligation is such that the Principal, designated as Contractor in the
foregoing Contract No. _____ shall faithfully perform the Contract on his part and
satisfy all claims and demands incurred for the same and shall pay all bills for labor, material,
equipment and all other items contracted for, or used by him, in connection with the Work
contemplated by said Contract, and shall fully reimburse the Obligee for all outlay and expense
which the Obligee may incur in making good any default of said Principal, then this Obligation
shall be null and void; otherwise it shall remain in full force and effect.

Signed and sealed this _____ day of _____, A.D., 201____

Witnesses:

CONTRACTOR

_____	_____ (SEAL)
_____	_____ (SEAL)
_____	_____ (SEAL)

SURETY

_____	_____ (SEAL)
_____	_____ (SEAL)
_____	_____ (SEAL)

(Surety must attach copy of Power of Attorney showing authority of Office or Agent to execute bonds)

FINAL LIEN AND CLAIM WAIVER AND AFFIDAVIT

Upon receipt of the sum of _____, which sum represents the total amount paid, including the current payment for work done and materials supplied for Project No. _____, in _____, Maine, under the undersigned's Contract with the Maine Turnpike Authority.

The undersigned, on oath, states that the Final Payment of _____ is the final payment for all work, labor, materials, services and miscellaneous (all of which are hereinafter referred to as "Work Items") supplied to the said Project through _____ and that no additional sum is claimed by the undersigned respecting said Project.

The undersigned, on oath, states that all persons and firms who supplied Work Items to the undersigned in connection with said Project have been fully paid by the undersigned for such Work Items or that such payment will be fully effected immediately upon receipt of this payment.

In consideration of the payment herewith made, the undersigned does fully and finally release and hold harmless the Maine Turnpike Authority, and its Surety, if any, from any and all claims, liens or right to claim or lien, arising out of this Project under any applicable bond, law or statute.

It is understood that this Affidavit is submitted to assure the Owner and others that all liens and claims relating to the Work Items furnished by the undersigned are paid.

(Contractor)

By: _____

Title: _____

State of MAINE

County of _____

I, _____, hereby certify on behalf of _____
(Company Officer) (Company Name)

its _____, being first duly sworn and stated that the foregoing representations are
(Title)

are true and correct upon his own knowledge and that the foregoing is his free act and deed in said capacity
and the free act and deed of the above-named

(Company Name)

The above-named, _____, personally appeared before me this ____ day of _____ and swears that this is his free act and deed.

(SEAL)

Notary Public

My Commission Expires: _____

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART I – SUPPLEMENTAL SPECIFICATIONS

(Rev. November 10, 2016)

The Supplemental Specifications are not included in these contract documents but are available at <https://www.maineturnpike.com/Projects/Construction-Related-Documents.aspx> for download.

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART II – SPECIAL PROVISIONS

PART II - SPECIAL PROVISIONS

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626	FOUNDATIONS, CONDUIT, AND JUNCTION BOXES FOR HIGHWAY SIGNING, LIGHTING, AND SIGNALS (Quazite Junction Box)	SP-28
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800	KENNEBUNK MAINTENANCE BUILDINGS (Fire Protection and Structural Improvements (8 Bay South)) (Fire Protection and Structural Improvements (8 Bay North)) (Fire Protection Improvements (10 Bay and adjoining 4 Bay Storage)) (Fire Protection Improvements (10 Bay))	SP-31
825	WATER MAINS AND SERVICES (6" HDPE DR 9 Plastic Main and Service) (6" Ductile Iron Class 52 Pipe) (Fire Hydrant)	SP-34
832	SITE BOLLARDS	SP-39

(See Appendix for Divisions 02 Thru 28)

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART II - SPECIAL PROVISIONS

All work shall be governed by the Maine Department of Transportation Standard Specifications, Revision of November 2014, except for that work which applies to sections of the Maine Department of Transportation Standard Specifications which are amended by the Maine Turnpike Supplemental Specifications and the following modifications, additions and deletions.

General Description of Work

10 Bay Maintenance Garage with 4 Bay Storage and Offices:

- a. Remove two existing windows between maintenance garage and offices and in-fill with CMU.
- b. Remove sprinkler heads that are adjacent to existing windows to be removed between maintenance garage and offices.
- c. Reconfiguration on some of the existing sprinklers for adherence to current code requirements.

New Fire Protection (Sprinklers & Alarm Monitoring System) for the following buildings:

1. Eight Bay North Garage
 2. Eight Bay South Garage
 3. Ten Bay Garage
- a. Installation of a fire protection (sprinklers) and alarm monitoring system.

Site/Civil:

- a. Addition of 6-inch water main to service each building that will incorporate a sprinkler system (Eight Bay North Garage, Eight Bay South Garage and Ten Bay Garage). New water main will connect to the existing water main on the property.
- b. Site work to include pavement removal, trenching, repaving, etc.

Electrical System Upgrade:

- a. Replace electrical system (replace wiring, outlets, switches, service panel(s), etc.) in the Eight Bay Garages (North & South). Note – the upgrade only pertains to the original portion of the building and not the 2018 addition.

Restroom Renovation

- a. Demo existing restroom and adjacent storage room.
- b. Construction of new larger restroom for increased space and fixtures.

Attic Access Ladder

- a. Addition of a fixed ladder to gain access to the attic's access hatch in the Eight Bay Garages (North & South).

Man Doors

- a. Replace two-man doors with wiring to junction boxes in each garage for the addition of access controls in the Eight Bay (North & South) and 10 Bay Garages. Note, the addition of the access controls is by others.

Plans

The drawings included in these Contract Documents, and referred to as the Plans, show the general character of the work to be done under this Contract. They bear the general title "Maine Turnpike – Contract 2026.08 – KENNEBUNK MAINTENANCE FIRE PROTECTION MITIGATION Mile 25.3" The right is reserved by the Resident to make such minor corrections or alterations in the Plans as he deems necessary without change in the unit prices on the Schedule of Prices of the Proposal.

101.2 DefinitionHolidays

The following is added after Memorial Day in the Supplemental Specifications:

Juneteenth 2026	12:01 p.m. (Noon) preceding Thursday to 6:00 a.m. the following Monday.
Independence Day 2026 (Fourth of July)	12:01 p.m. (Noon) preceding Friday to 6:00 a.m. the following Monday.
Christmas 2026	12:01 p.m. (Noon) preceding Thursday to 6:00 a.m. the following Monday
New Years 2027	12:01 p.m. (Noon) preceding Thursday to 6:00 a.m. the following Monday.

103.4 Notice of Award

The following sentence is added:

The Maine Turnpike Authority Board is scheduled to consider the Contract Award on May 28, 2026.

104.3.8 Wage Rates and Labor Laws

Section 104.3.8 Wage Rates and Labor Laws have been amended as follows:

The fair minimum hourly rates determined by the State of Maine Department of Labor for this Contract are as follows:

THIS DOCUMENT MUST BE CLEARLY POSTED AT ALL CONSTRUCTION SITES FUNDED IN PART WITH STATE FUNDS

State of Maine
Department of Labor
Bureau of Labor Standards
Augusta, Maine 04333-0045
Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid to laborers and workers employed on the below titled project.

2026 Fair Minimum Wage Rates – Building 2 York County (other than 1 & 2 family homes)

Occupational Title	Minimum Wage	Minimum Benefit	Total
Brickmasons and Blockmasons	\$43.91	\$11.02	\$54.93
Bulldozer Operator	\$30.62	\$5.38	\$36.00
Carpenter	\$30.01	\$19.69	\$49.70
Cement Masons and Concrete Finisher	\$23.95	\$2.73	\$26.68
Construction and Maintenance Painters	\$26.23	\$2.81	\$29.04
Construction Laborer	\$21.90	\$19.72	\$41.62
Conveyor Operators and Tenders	\$30.17	\$13.77	\$43.94
Crane and Tower Operators	\$40.43	\$8.63	\$49.06
Crushing Grinding and Polishing Machine Operators	\$26.15	\$3.24	\$29.39
Earth Drillers - Except Oil and Gas	\$25.04	\$3.77	\$28.81
Electrical Power - Line Installer and Repairers	\$48.12	\$15.63	\$63.75
Electricians	\$38.75	\$21.52	\$60.27
Elevator Installers and Repairers	\$72.19	\$44.52	\$116.71
Excavator Operator	\$31.75	\$5.53	\$37.28
Fence Erectors	\$26.69	\$3.29	\$29.98
Flaggers	\$21.39	\$0.86	\$22.25
Floor Layers - Except Carpet/Wood/Hard Tiles	\$29.00	\$8.65	\$37.65
Glaziers	\$39.32	\$19.22	\$58.54
Hazardous Materials Removal Workers	\$25.01	\$2.04	\$27.05
Heating and Air Conditioning and Refrigeration Mechanics and Installers	\$36.11	\$6.39	\$42.50
Heavy and Tractor - Trailer Truck Drivers	\$26.10	\$4.07	\$30.17
Highway Maintenance Workers	\$23.30	\$1.14	\$24.44
Industrial Machinery Mechanics	\$29.97	\$6.74	\$36.71
Industrial Truck and Tractor Operators	\$24.61	\$4.21	\$28.82
Insulation Worker - Mechanical	\$28.57	\$17.06	\$45.63
Light Truck or Delivery Services Drivers	\$26.79	\$5.14	\$31.93
Loading Machine and Dragline Operators	\$32.79	\$4.40	\$37.19
Millwrights	\$35.99	\$10.52	\$46.51
Mobile Heavy Equipment Mechanics - Except Engines	\$26.43	\$5.48	\$31.91
Operating Engineers and Other Equipment Operators	\$47.25	\$31.30	\$78.55
Paving Surfacing and Tamping Equipment Operators	\$30.74	\$10.67	\$41.41
Pile-Driver Operators	\$37.15	\$3.12	\$40.27
Pipe/Steam/Sprinkler Fitter	\$43.76	\$25.44	\$69.20
Pipelayers	\$28.75	\$3.64	\$32.39
Plumbers	\$40.00	\$24.71	\$64.71
Radio Cellular and Tower Equipment Installers	\$34.72	\$5.63	\$40.35
Reinforcing Iron and Rebar Workers	\$48.19	\$1.93	\$50.12
Riggers	\$27.16	\$21.25	\$48.41
Roofers	\$28.42	\$4.56	\$32.98
Sheet Metal Workers	\$30.18	\$6.64	\$36.82
Structural Iron and Steel Workers	\$32.94	\$25.00	\$57.94
Tapers	\$31.43	\$5.47	\$36.90
Telecommunications Equipment Installers and Repairers - Except Line Installers	\$32.28	\$14.53	\$46.81
Telecommunications Line Installers and Repairers	\$30.00	\$2.20	\$32.20
Tile and Marble Setters	\$28.91	\$5.46	\$34.37

Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)

Apprentices – The minimum wage rates for registered apprentices are the rates recognized in the sponsorship agreement for registered apprentices working in the pertinent classification.

For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.

Title 26 §1310 requires that a clearly legible statement of all fair minimum wage and benefits rates to be paid the several classes of laborers, workers and mechanics employed on the construction on the public work must be kept posted in a prominent and easily accessible place at the site by each contractor and subcontractor subject to sections 1304 to 1313.

Appeal – Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates.

A true copy

Attest:

 Scott

R. Cotnoir
Wage & Hour Director
Bureau of Labor
Standards

Supersedes 02-03-2025
Effective 01-10-2026

104.4.6 Utility Coordination

This Subsection is amended by the addition of the following:

These Special Provisions outline the arrangements which have been established by the Authority for coordination of the work to be accomplished by the utilities. The scope and schedule of utility relocation work is noted herein. The Contractor shall plan and conduct his work accordingly.

General

Utility working days are Monday through Friday, conditions permitting. Times are estimated on the basis of a single crew for each utility. Any times and dates mentioned are estimates only and are dependent upon favorable weather, working conditions, and freedom from emergencies. The Contractor shall have no claim against the Authority if they are exceeded.

The Contractor shall plan and conduct his operations in accordance with the following utility schedule. The Contractor must comply with all OSHA regulations pertaining to work adjacent to utility wires. The Contractor shall plan and conduct his work accordingly.

The following utilities are located within the Project limits. The Contractor shall ascertain the location of the existing utilities and any other necessary information by direct inquiry at the office of the following utility owners:

AERIAL AND UNDERGROUND UTILITIESCOMMUNICATION:

Fidium Fiber
600 Sable Oaks Dr.
South Portland, ME 04106
Attn: Patrick Morrison 207-745-9363

CABLE TELEVISION:

Spectrum
118 Johnson Road
Portland, ME. 04102
Attn: Mark Pelletier 207-253-2324

ELECTRIC:

Kennebunk Light & Power District
4 Factory Pasture Lane
Kennebunk, ME 04043
(207) 985-331

NATURAL GAS

Maine Natural Gas
9 Industrial Parkway
Brunswick, ME. 04011
207-729-0420

SEWER

Kennebunk Sewer District
44 Water Street
Kennebunk, ME 04043
207-985-4741

WATER

Kennebunk, Kennebunkport & Wells Water District
92 Main Street
Kennebunk, ME. 04043
207-985-8524 x. 210
Attn: Jamie Paschal

104.4.7 Cooperation With Other Contractors

This Subsection is amended by the addition of the following:

Adjacent contracts currently scheduled for the 2026 construction season include:

MTA Contract 2026.02 – Main Line Paving MM 27.2 to 30.3
MTA Contract 2026.06 – Bridge Repairs

The following Subsection is added:

105.2.4.2 Lead Paint

The Contractor shall note that the 8 Bay (North & South) garages, 10 Bay garage and Office/10 Bay with Four Bay Storage garage contains lead containing paint. A copy of the Hazardous Material Report is attached as **Appendix A**. The Contractor shall institute every precaution when working with materials coated with lead containing paints.

Lead Paint Removal

The Contractor is required to remove and dispose of lead containing paint and paint residue before cutting, grinding, drilling and sandblasting existing materials in preparation of completing the work except as provided under the Drilling of Lead Based Paint subsection in this Special Provision. All lead containing paint and paint residue shall be removed, handled, stored and disposed of in conformance with all local, State and Federal laws and regulations governing lead containing paint. The Contractor may use his own properly trained employees to abate the lead containing paint in accordance

with applicable regulations and requirements; or he may hire a licensed lead abatement subcontractor to abate the lead containing paint in accordance with applicable regulations and requirements.

The Contractor, or licensed lead abatement subcontractor, shall submit a Project specific Health and Safety (OSHA) Plan and a Hazardous Waste Management Plan (EPA/DEP) a minimum of two (2) weeks prior to undertaking the removal of lead containing paint.

Drilling of Lead Based Paint

The Contractor may drill lead based painted steel, without lead based paint removal, provided the Contractor collects and recycles the drill cuttings at a licensed metal recycling facility. If the Contractor chooses not to collect and recycle the drill cuttings at a licensed metal recycling facility he will be required to abate the area where drilling is to occur in full accordance with the lead containing paint removal, storage and disposal requirement of this Special Provision.

The Authority will require a signed statement from the Contractor stating the drill cuttings were collected and recycled at a licensed metal recycling facility and the name the recycling facility.

Health and Safety Plan

The Health and Safety Plan submittal shall describe how the Contractor/licensed lead abatement subcontractor intends to remove the lead containing paints; and shall outline how the Contractor/licensed lead abatement subcontractor will adhere to all Federal, State and local ordinances which govern worker (including authorized representatives of the Authority) exposure to lead based paints, and ensure the safety of the workers performing lead removal. Copies of current worker training certificates (OSHA), medical screenings, and respirator fit up shall be included in the submittal.

Hazardous Waste Management Plan

The Hazardous Waste Management Plan submittal shall describe how the Contractor/licensed lead abatement subcontractor intends to manage the hazardous waste that will be generated, temporarily accumulated, stored, transported off-site and disposed; adhere to ordinances associated with the management of hazardous wastes; and ensure protection of the environment.

The Hazardous Waste Management Plan shall:

- Be signed by the Contractor;
- State whether Contractor or licensed lead abatement subcontractor will be undertaking the work; and,
- State whether abated lead materials will be accumulated and stored on-site (required if Contractor is not licensed by DEP/EPA to transport and temporarily store lead based hazardous waste), or be removed in HEPA vacuums daily to the removal Contractor's licensed waste storage facility (permitted only if Contractor is licensed by DEP/EPA to transport and temporarily store lead based hazardous waste).

If abated lead materials are to be accumulated and stored on-site, the Hazardous Waste Management Plan shall include (at a minimum) the following:

- Container size and labeling standards:
 - Containers must be 55 gallons or less
 - Containers must have the labeled “HAZARDOUS WASTE”
- Accumulation requirements:
 - Labels will include accumulation start date and container full date
 - On-site storage will not exceed 180 days from full date
 - Total on-site storage shall not exceed 55 gallons or 220 pounds
- Inspections (including frequency and checklist):
 - Inspections shall be performed each day the Contractor works
 - Inspection checklist shall be similar to MaineDEP format (Refer to Appendix A1 of MaineDEP Handbook for Hazardous Waste Generators – January 2008)
- Transport and DOT “pre-transport requirements”:
 - Specify the licensed hazardous waste transporter to be used
 - Obtain Generator’s EPA ID No. (typically a provisional ID # is obtained through the licensed hazardous waste transporter)
 - USDOT – approved containers must be used for shipment
 - Schedule MTA for signing Hazard Waste Manifest
- Recordkeeping requirements:
 - Describe where at the jobsite the required records (e.g., inspection logs, training records, Lead Determination report/hazardous waste characterization, etc.) will be maintained
 - Describe how and when copies of the required documents specified above will be transferred to the MTA Environmental Services Coordinator’s office

The Contractor/licensed lead abatement subcontractor, shall provide documentation to the MTA that the employees who will be removing, handling, managing and/or directly supervising the hazardous waste operations have received required Resource Conservation and Recovery Act (RCRA) hazardous waste management training, and all training is current.

The lead based hazardous waste must remain on-site, unless the removal is being performed by a licensed lead abatement subcontractor that collects the paint residue in HEPA vacuums and is licensed by DEP/EPA to transport and temporarily store lead based hazardous waste at the removal Contractor’s licensed waste storage facility. Both on-site and licensed off-site lead based hazardous waste storage facilities require secure storage and daily inspection of the stored waste.

If the removal Contractor is not licensed by DEP/EPA to transport and temporarily store lead based hazardous waste off-site, then an EPA licensed Hazardous Waste transporter(s) shall be used to remove hazardous waste from the site. All removal and disposal documentation will be required when the hazardous waste leaves the site. As the Generator, only the Authority’s Environmental Services Coordinator or his trained designee shall sign waste manifests when material is removed from the Project site.

The removal, storage, handling, transporting, and disposal of lead containing paint and lead based paint residue will not be measured separately for payment, but shall be incidental to the various Contract work items.

The following Subsection is added:

105.2.4.3 Asbestos

The Contractor shall note that the existing structure(s) has/have tested negative for asbestos containing materials. A copy of the Hazardous Material Report is attached as **Appendix A**.

Whereas no Asbestos Containing Material Determination Survey is 100 percent accurate, building demolition activities shall be accomplished under the supervision of a "competent person", as defined by OSHA, to evaluate whether materials uncovered/exposed are asbestos containing materials. If the "competent person" observes, or believes he has observed, asbestos containing materials while demolition is underway, the "competent person" shall immediately stop the demolition, secure the site and notify the Project Resident/Inspector.

The Owner shall have the area tested for asbestos containing materials. No work will be permitted in the area until samples show that no asbestos containing materials exists, or if asbestos containing materials are present, the conditions are abated. Compensation for delays resulting from stopping the demolition, testing for asbestos containing materials, and abating asbestos containing materials, if they exist, shall be limited to a time extension.

105.8.2 Permit Requirements

The Project is subject to the Stormwater Memorandum of Agreement for Stormwater Management Between the Maine Department of Transportation, Maine Turnpike Authority, and Maine Department of Environmental Protection (Stormwater MOA). Under the Stormwater MOA, all MTA construction, operation, and maintenance activities are subject to Maine Stormwater Law Basic Standards through implementation of MaineDOT's Best Management Practices for Erosion and Sedimentation Control (MaineDOT BMP Manual), which are the Contractor's responsibility to implement.

The Contractor shall prepare a LOD plan illustrating the Contractor's proposed limit of earthwork disturbance. The LOD plan shall show all construction access locations, field office locations, material and temporary waste storage locations, as well as include the Contract limits of earthwork disturbance. All applicable erosion and sedimentation control devices needed shall be detailed on the Contractor's LOD plan and are not limited to those devices shown on the Contract LOD plan. **This Plan shall be submitted for review and approval, to the Resident within 14 days of Contract award.** Payment for creating, revising, and completing this plan shall be incidental to Item 659.10, Mobilization.

If at any time during the Contract, the Limit of Disturbance needs to be adjusted to accommodate construction activities, the Contractor shall resubmit the LOD plan (including any additional erosion and sedimentation control measures needed) to the Resident for review and approval prior to any additional disturbance taking place:

- If the cumulative area of disturbance is less than one acre, the Resident shall have a minimum of five (5) working days to approve the revised LOD plan.
- If the cumulative area of disturbance exceeds one acre, the Resident shall first approve of the plan and then possibly submit a MCGP NOI to Maine DEP for approval. The approval may take a minimum of 14 working days from the date of submittal to Maine DEP.

Compliance with the erosion and sedimentation control requirements outlined in this Contract is required by the Contractor.

105.11 As-Built Plans

The Contractor shall provide the Authority with as-built plans in PDF and MicroStation or AutoCAD. The as-built plans shall note changes to the bid documents, including, but not limited to pavement, concrete, barrier, guardrail, culverts, drainage, foundations, wiring, signs, etc. The as-builts plans shall also provide GPS accurate locations of all underground work. Submittal of Draft, Final Draft, and 100% as-built plans to the Resident shall be conditions of Mobilization Payment, Retainage Reduction, and Final Payment as noted in Special Provision 108.

105.11.1 As-Built Plan Submittals

The Contractor shall make the following submittals of as-built plans to the Resident as part of the conditions of Mobilization Payment, Retainage Reduction, and Final Payment as noted in Special Provision 108:

- a. Draft As-built Plans containing any underground work completed within the prior 30 day period once 50% of the Work is complete.
- b. Final Draft As-Built Plans containing all underground work
- c. 100% As-Built Plans containing all underground work and changes

105.11.2 As Built Plan Requirements

As-built plans and CADD files shall conform to the following requirements:

- a. Include legend of line weights and styles
- b. Project stationing shall be on its own layer and be color white
- c. Changes to pavement, concrete, barrier, guardrail, foundations, signs etc. shall be on their own layer and be color brown
- d. Electric power lines, cable, conduit, and lighting cables shall be on their own layer and be color red
- e. Gas, oil, steam, petroleum, or gaseous materials shall be on their own layer and be

color yellow

- f. Communication, alarm or signal lines, cables, or conduit shall be on their own level and be color orange
- g. Potable water shall be on its own layer and be color blue
- h. Sewers and drain lines shall be on their own layer and be color green
- i. Reclaimed water, irrigation, and slurry lines shall be on their own level and be color purple

107.1 Contract Time and Contract Completion Date

This Subsection is amended by the addition of the following:

- The construction of the Kennebunk Maintenance Facilities Fire Protection Design shall be substantially complete by November 6, 2026.
- All civil site work to be completed and seeded by October 1, 2026
- All work shall be completed on or before December 4, 2026.

The MTA will entertain a start date for this work after a successful MTA Board Approval on May 28, 2026. The contractor shall anticipate long lead time items and move immediately into the design and shop drawing submittal phase of such items. Liquidated damages will occur for each day after the above noted dates.

107.1.1 Substantial Completion

This Subsection is amended by the addition of the following:

Substantially complete shall be defined by the Authority as the following:

- All fire protection sprinklers, sprinkler monitoring equipment, and riser assembly installed and operational in the Eight Bay (North & South) and 10 Bay Garages.
- Fire Protection water main installed, tested, and operational.
- All disturbed areas related with the installation of the fire protection water main to be filled and/or repaved.
- Fixtures for restroom renovation in Eight Bay (North) garage are to be tested and operational.
- All electrical system devices replaced are to be tested and operational in the Eight Bay Garages (North & South)
- Windows in separation wall between 10 Bay Maintenance garage and office spaces to be removed and in-filled, adjacent window fire sprinklers removed and pressure tested, reconfigured sprinklers to be tested, and storage room 121 fire rated penetration sealant installed.
- Fixed access ladders to the attic's access hatch in the Eight Bay (North & South) garages are to fully installed.
- Two man doors with wiring to junction boxes for installation of access controls to be installed in each garage (Eight Bay – North & South and 10 Bay). Note, access controls to be installed by others.

Supplemental Liquidated damages on a calendar day basis in accordance with Subsection 107.8 shall be assessed for each calendar day that substantial completion is not achieved.

107.1.2 Limitation of Operations

Construction of the Fire Protection Mitigation shall not, in the opinion of the Resident, prohibit the safe and reasonable operations of the MTA maintenance crews. MTA will provide clear access to the maintenance garages Eight Bay (North & South) and 10 Bay Maintenance Garages during construction as per the contractors approved schedule. MTA will also provide clear access to the areas in the Office/10 Bay Maintenance Garage with Four Bay Storage Building as per the contractors approved schedule. The contractor shall provide clear access to all areas that are outside of the designated construction areas throughout construction.

The Contractor shall submit their proposed staging, storage, and construction areas for approval to the Resident. The contractor shall be responsible for minimizing the footprint of the project, and resulting impacts to the MTA, to the extent practical. The Authority will allow the contractor store materials on site prior to starting work. Site access and final area used for storage shall be coordinated and approved by the Resident.

The Contractor shall be responsible for ensuring that the work associated with this project does not interfere with MTA operations. All trenching shall be backfilled or covered with steel plates nightly and appropriate traffic controls shall be maintained throughout the yard (i.e., traffic cones or barrels around excavated areas).

107.4.6 Prosecution of Work

The Contractor shall submit to the Authority a construction schedule which shall document that the Contractor has the necessary labor and equipment to work immediately and continuously at the project site once the garages are made accessible. The intent of this specification is to minimize the amount of time that MTA has inaccessibility to the garages, while providing the Contractor sufficient time to complete the work in a diligent manner and hand the garages back over to MTA as prescribed by the project's Substantial Completion date.

The Contractor is to schedule the work such that MTA has full access to at least one of the three garages (Eight Bay – North & South and Ten Bay) during the construction period. This sequence/phasing of construction is to be reflected in the construction schedule.

108.2.1 Generation of Progress Payments

The Authority will estimate the amount of Work performed at least monthly and make payment based upon such estimates. Estimates may be paid ~~bimonthly (twice-a-month)~~ ~~the bimonthly (twice-a-month) invoices exceed \$100,000.~~ No such estimates or payment will be made if, in the judgment of the Authority, the Work is not proceeding in accordance with the provisions of the Contract. The Contractor agrees to waive all claims related to the timing and amount of such estimates.

108.2.3 Mobilization Payment

The second paragraph is deleted in its entirety and replaced with the following:

Upon approval of all pre-construction submittals required for approval by this Contract, including those listed in Section 104.4.2 – Preconstruction Conference, the Contractor will receive payment of 50% of the Lump Sum price for Mobilization, not to exceed 5% of the Bid less the amount bid for Mobilization. After the Authority determines that the Work is 50% complete and the Contractor has submitted a Draft (50%) as-built submittal of all underground work to date (within the prior 30 day pay period) as defined in Special Provision 105., the Contractor will receive the other 50% of the Lump Sum price for Mobilization, not to exceed 5% of the Bid less the amount bid for Mobilization. Any remaining Mobilization will be at the completion of physical work.

108.3 Retainage

The seventh paragraph is deleted in its entirety and replaced with the following:

When requested by the Contractor, an 80 percent reduction of retainage will be considered by the Authority when the Project is substantially complete and the Contractor has submitted a Final Draft (98%) as-built submittal of all underground work, in accordance with Special Provision 105. When requesting a reduction, the Contractor shall include an explanation of the outstanding Work, an estimate of the cost to complete the Work, and a schedule for completing the Work. Seasonal limitations as well as warranty and establishment periods (for vegetation) shall be addressed.

SPECIAL PROVISION

SECTION 203

EXCAVATION AND EMBANKMENT

203.01 Description

The following paragraph is added:

The work shall consist of cutting, removing, and disposing of full depth existing bituminous concrete pavement as shown on the Plans, or as approved by the Resident. The pavement shall be sawcut to the full depth of pavement at the limits of the excavation to provide a clean, vertical cut surface. The surface pavement adjacent to the sawcut shall then be milled 1½” as shown in the Pavement Sawcut detail included in the plans.

Common excavation shall include all excavation (including over excavation) within the project limits. This shall include the complete removal and disposal of all material unsuitable for re-use on the project, existing pavement, topsoil, organics, foundations, utilities, relic materials, and structures.

During excavation if suitable material is encountered, it may be left in place or re-used on other portions of the project with approval from the Resident, and in accordance with the Plans and these Specifications.

Fill to raise grades in landscaped and/or seeded areas shall be compactable earth meeting the requirements of Maine DOT Standard Specification 703.18, Common Borrow.

Fill to raise grades in paved areas, and in areas of backfill for over excavations, shall meet the requirements of Maine DOT Standard Specification 703.19, Granular Borrow for Embankment Construction, except that portion passing the No. 200 sieve shall be 7.0% or less.

Crushed Stone as noted on the plans, used for underdrain aggregate shall be washed ¾ inch crushed stone meeting the requirements of Maine DOT Standard Specification 703.22, Underdrain Backfill Material, Type C.

203.04 General

The following sentence is added to the end of the third paragraph.

There are no approved waste storage areas or waste areas within the Project limits unless shown on the Plans. Unsuitable materials shall be disposed of off-site in accordance with Subsection 203.06.

All excavations shall be accomplished in accordance with the applicable OSHA Standards.

The Resident reserves the right to request the Contractor to prepare an excavation plan. This plan shall include, but not necessarily be limited to, the limit and depth of excavation, side slope, shoring, trench box and utility support.

The on-site soils may be suitable for reuse on site. Materials meeting the requirements for Common Borrow may be used as fill in landscaped and/or seeded areas, provided they are at a compactable moisture content at the time of reuse. Materials meeting the requirements for Granular Borrow may be used as fill provided, they are free of organics and deleterious material and are at a compactable moisture content at the time of reuse. The Contractor shall have test pits performed by a certified soil scientist to assess suitability for reuse of existing material. Test pits to determine the suitability of existing materials will be considered incidental to the project. Relic buried organic materials are unsuitable for reuse.

203.10 Embankment Construction - General

The thirteenth and fourteenth paragraphs are deleted and replaced with the following:

All portions of the embankment shall be compacted in accordance with the designated embankment compaction requirements specified for the Project.

The existing slopes shall be benched as shown on the drawings prior to placing additional fill of any kind. Embankment fill of any kind, should be placed in lifts which extend laterally beyond the limits of the design side slopes such that the specified degree of compaction is achieved within the limits of the completed embankment. The slopes should then be trimmed back to design dimensions.

Fill and backfill shall be compacted to at least 95% of its maximum dry density as determined by ASTM D-1557.

203.16 Winter Construction of Embankments

The word "core" is deleted from the first and second sentences in the first paragraph.

203.18 Method of Measurement

There will be no additional measurement and payment for the required excavation plan, and costs shall be incidental to the Excavation items.

Saw cutting and milling along the perimeter of pavement removal shall be measured for payment under their respective pay items.

SPECIAL PROVISIONSECTION 403HOT MIX ASPHALT PAVEMENTProject Pavement**Full Depth**

Course	HMA Grading	Item Number	Total Thickness	No. of Layers	Complimentary Notes
Base	12.5mm	403.207	2 ½"	1	C,I
Wearing	12.5mm	403.207	1 ½"	1	C,I

COMPLEMENTARY NOTES

- A. The required PGAB for this mixture shall be **64E-28**.
- B. RAP may not be used, except for areas shown on the plans.
- C. The Maine DOT will conduct the job mix verification. The aggregate qualities shall meet the design traffic level of 3 to <10 million ESALS for mix placed under this contract. Minimum and Maximum PGAB content limits from 401.21 shall not apply.
- D. The MTA will conduct the job mix verification. The aggregate qualities shall meet the design traffic level of 10 to <30 million ESALS for mix placed under this contract. The design verification, Quality Control, and Acceptance tests for this mix will be performed at **75 gyrations**. (N design)
- E. A material transfer vehicle (MTV) shall be used for the placement of Hot Mix Asphalt wearing surface on all roadways including acceleration and deceleration lanes and all ramps.
- F. Joints shall be constructed as the “notched wedge” type in accordance with Subsection 401.17.
- G. Joint density will be measured in accordance with Subsection 401.165.
- H. PGAB shall conform to the provisions of 403.02 – Polymer Modified PGAB for HMA
- I. The contractor shall furnish a quality control technician equipped with an approved densometer to ensure density requirements are met.

- J. Hydrated Lime shall be incorporated into the mixture.
- K. The antistrip additive Zycotherm manufactured by Zydex Industries shall be incorporated into the PGAB at a rate of 0.1%.

SPECIAL PROVISION

SECTION 409

BITUMINOUS TACK COAT

409.01 Description

This Subsection is deleted and replaced with the following:

This work consists of furnishing and applying one uniform application of Emulsified Asphalt RS-1 or RS-1h conforming to the specifications of AASHTO M-140. The application rate shall be 0.04 gal/yd²

A tack coat is required between pavement lifts as well as on all sawcut butt joints.

409.05 Equipment

Add “or as determined by the Resident”, after the words “gal/yd²” in the fourth line of the second paragraph of this Subsection.

409.06 Preparation of Surface

The following paragraph is added:

All existing pavement and shoulder areas on which bituminous concrete mixtures are to be placed shall receive a tack coat. The surface area where the tack coat is to be applied shall be dry and cleaned of all dirt, sand, and loose material. Cleaning shall be accomplished by use of revolving brooms or mechanical sweepers. Undesirable material not removed by the above means shall be cleaned by hand sweeping or scraping, or a combination of both. Small areas otherwise inaccessible may be swept with hand brooms. The tack coat shall be applied only when the existing surface is dry.

409.08 Method of Measurement

The following paragraphs are added:

Measurement will be based on delivery slips made out in duplicate by the Contractor and signed by the Resident, or his representative, at the point of delivery. One of these slips shall be retained by the Resident and one by the Contractor. Delivery slips shall be furnished by the Contractor and shall provide space for identifying the vehicle and driver, for stating the volume of material carried, the source of the material, the date, and the Resident or his representative's signature.

Material included in the delivery slips and not used or rejected shall be deducted from the amount being measured for payment. Each day's delivery slips shall be reconciled by the Contractor and the Resident within 24-hours.

Cleaning of the surface area where tack coat is to be applied shall be incidental to Item 409.15, Bituminous Tack Coat - Applied.

409.09 Basis of Payment

The following pay items are added:

<u>Pay Item</u>	<u>Pay Unit</u>
409.15 Bituminous Tack Coat RS-1 or RS1h – Applied	Gallon

SPECIAL PROVISIONSECTION 419SAWING AND SEALING JOINTS IN BITUMINOUS PAVEMENT

(Sawing Bituminous Pavement)

419.01 Description

This work consists of sawing bituminous concrete pavement as shown on the Plans, as specified herein or as approved by the Resident.

419.02 General

The bituminous concrete pavement to be sawed shall be accurately marked before cutting. The marking shall be in accordance with the locations as shown on the Plans or as approved by the Resident. Cutting shall be with an approved power-driven saw with an abrasive blade.

Unless otherwise noted or directed, the sawcut shall be vertical, a minimum of 3/8 inch wide, and extend to the depth as shown on the Plans.

Residue or debris from the sawing operation shall be removed immediately and legally disposed of by the Contractor.

419.03 Method of Measurement

Sawing Bituminous Pavement will be measured by the linear foot of pavement actually cut and accepted. No additional payment will be made for variations in the pavement thickness.

419.04 Basis of Payment

Sawing Bituminous Pavement will be paid for at the Contract unit price per linear foot which shall be full compensation for all materials, tools, equipment labor, and all incidentals necessary for the completion of the work to the satisfaction of the Resident. The disposal of sawcut residue shall be incidental to this item.

Payment will be made under:

Pay ItemPay Unit

419.30 Sawing Bituminous Pavement

Linear Foot

SPECIAL PROVISION

SECTION 502

STRUCTURAL CONCRETE

502.01 Description

The following paragraphs are added:

The work shall consist of installing concrete thrust blocks and filling steel bollards with concrete in accordance with these Specifications and in conformity with the details and dimensions shown on the Plans.

All work shall be completed in accordance with Supplemental Specifications, Section 502, for cast-in-place concrete.

502.02 Materials

All concrete, whether precast or cast-in-place, shall be Class “B” meeting the requirements of the MTA’s Supplemental Specifications, Section 502.

Pay Item

Pay Unit

502.56 Structural Concrete (Type B)

Cubic Yard

SPECIAL PROVISION

SECTION 619

MULCH

(Temporary Mulch)

619.01 Description

The first paragraph is modified by the addition of the following:

“as a temporary or permanent erosion control measure” after the word “mulch”.

Add the following sentence at the end of the first paragraph:

Refer to plans, for more information on Temporary Mulch.

619.03 General

The first paragraph is deleted and replaced with the following:

Cellulose fiber mulch shall not be used within 200 feet of a wetland or stream. The limits shall be 200 feet up station and down station of the wetland or streams as well as the slopes adjacent to the stream. The application of hay or straw mulch with an approved binder shall be used at these locations to prevent erosion.

The use of cellulose fiber mulch will only be allowed at other areas with the approval of the Resident. The Contractor may be required to demonstrate that the material may be applied in a manner that will prevent erosion and will aid in the establishment of permanent vegetation. The Resident reserves the right to require the use of hay or straw mulch at all locations if he determines that the cellulose mulch is ineffective. Cellulose fiber mulch is not acceptable for winter stabilization.

619.06 Method of Measurement

The following sentence is added:

Temporary Mulch will be paid for by the lump sum.

619.07 Basis of Payment

Temporary Mulch will be paid for at the Contract price per lump sum which shall be full compensation for furnishing and spreading the Temporary Mulch as many times as necessary as determined by the Contractor’s operations and staging. The price shall also include the additional mulch netting and snow removal necessary during the winter months.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
619.1202 Temporary Mulch	Lump Sum

SPECIAL PROVISION

SECTION 626

FOUNDATIONS, CONDUIT, AND JUNCTION BOXES
FOR HIGHWAY SIGNING, LIGHTING, AND SIGNALS

(Quazite Junction Box)

626.031 Conduit

The third paragraph shall be deleted and replaced with:

All junction or pull boxes shall be vehicle rated with a minimum design load of 22,000lbs and installed as shown on the plans. Junction boxes for the communication conduit associated with the project shall be polymer concrete as manufactured by QUAZITE® a division of Hubbell Power Systems, or an approved equal. The boxes shall be 36" x 24" and 21" deep as noted on the plans. The words COMMUNICATION shall be stamped on the cover as noted in the Plans or directed by the Resident.

The fourth paragraph shall be deleted and replaced with:

Where conduits enter exposed junction boxes, they shall be sloped to drain towards the conduit entrance holes, unless otherwise directed. All conduit ends in exposed junction boxes shall be fitted with bell ends. Weep holes of ¼ inch diameter shall be placed in all junction boxes.

The following shall be added to the end of the fifth paragraph:
During the backfilling of the trench, a "buried conduit" warning tape shall be placed above the conduit. This warning tape shall be capable of being located by a cable locator and shall be labeled and colored as appropriate to the type of utility the conduit is intended for.

626.04 Method of Measurement

The following sentence is added:

Quazite junction box shall be measured by each unit in place and accepted as shown in the plans.

626.05 Basis of Payment

The following sentence shall be added to the third paragraph:

The words, "polymer concrete" shall be added after the words, "precast concrete" in the second sentence of the second paragraph.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
626.121 Quazite Junction Box (36X24)	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(PVC Conduit)

655.01 Description

This task shall include providing and the installation of PVC Conduit as shown on the Plan drawings and described herein. All conduit shall be installed per NEC specification. Connections to specialized fittings are to be compatible with adjoining conduit.

655.03 General

See attached Division 26 – Electrical Specifications and related Specifications for details.

655.05 Method of Measurement

All conduit will be measured by the number of linear feet installed and accepted.

655.06 Basis of Payment

Measurement and payment for installing PVC Conduit as shown on the Plan drawings and described herein will be per linear foot of each type of underground or exposed conduit actually furnished, installed, and accepted at the Contract price per linear foot. This price shall include the furnishing, installing, supporting and connection of the conduit and all various hardware necessary for the installation, the cost of hand digging, trenching, excavating or plowing; furnishing and installing the conduit; furnishing special backfilling materials, pull string, fittings, groundings and bonding; test cleaning interiors of conduits and all materials, labor, equipment and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
655.2041 3” Schedule 80 PVC Conduit (1 Way Duct Bank)	Linear Foot
655.2043 3” Schedule 80 PVC Conduit (3 Way Duct Bank)	Linear Foot

SPECIAL PROVISION

SECTION 800

KENNEBUNK MAINTENANCE BUILDING

(Fire Protection and Structural Improvements)

800.01 Description

The following paragraph is added:

This work consists of the renovations for the following scope of work as shown on the construction drawings and described herein:

Eight Bay North Garage

- Installation of fire protection (sprinklers), sprinkler monitoring system, and fire protection riser equipment.
- Demolition of existing restroom and adjacent storage room to combine spaces for new restroom with fixtures.
- Replace existing electrical system (wiring, panel(s), switches, outlets, etc.) in the original section of the building. The 2018 addition does not require the electrical equipment to be replaced.
- Installation of two new man doors with wiring to junction boxes for the addition of access controls. Note: access controls are by others.

Eight Bay South Garage

- Installation of fire protection (sprinklers), sprinkler monitoring system, and fire protection riser equipment.
- Replace existing electrical system (wiring, panel(s), switches, outlets, etc.) in the original section of the building. The 2018 addition does not require the electrical equipment to be replaced.
- Installation of two new man doors with wiring to junction boxes for the addition of access controls. Note: access controls are by others.

Ten Bay Maintenance Garage/Office with Four Bay Storage Building

- Removal of two windows and infill with CMU in separation wall between maintenance garage and offices.
- Removal of sprinklers adjacent to windows to be removed in separation wall.
- Reconfiguration of sprinklers.

Ten Bay Garage

- Installation of fire protection (sprinklers), sprinkler monitoring system, and fire protection riser equipment.
- Installation of two new man doors with wiring to junction boxes for the addition of access controls. Note: access controls are by others.

800.02 Method of Payment

Installation of the fire protection (sprinklers), sprinkler monitoring system, and fire protection riser equipment will be measured by the lump sum.

Replacement of the electrical system will be measure by the lump sum.

Installation of the attic's fixed access ladder will be measure by the lump sum.

Replacement of man doors with wiring to junction boxes for access control will be measured by the lump sum. Note, the access control is by others.

Demolition of the existing restroom and adjacent storage room, along with the construction of the new restroom with be measured by the lump sum.

Installation of the fixed access ladder to the attic's access hatch with be measured by the lump sum.

Replacement of the man doors with wiring to the junction boxes for access control with will be measured by the lump sum. Note, access control is by others.

800.03 Basis of Payment

The installation of the fire protection (sprinklers), sprinkler monitoring system, and fire protection riser will be paid for at the Contract lump sum price.

The electrical system replacement will be paid for at the Contract lump sum price, which price shall be full compensation for the complete removal and legal disposal of the original electrical equipment.

The installation of the attic's fixed access ladder will be paid for at the Contract lump sum price.

The demolition of the existing restroom and adjacent storage room, along with the construction of the new restroom will be paid for at the Contract lump sum price, which price shall be full compensation for the complete removal and legal disposal of the original material.

The replacement of the man doors and wiring to junction boxes for access controls will be paid for at the Contract lump sum price, which price shall be full compensation for the complete removal and legal disposal of the original material.

Payment will be made under the following:

<u>Pay Item</u>		<u>Pay Unit</u>
800.701	Fire Protection and Structural Improvements (8 Bay South)	Lump Sum
800.702	Fire Protection and Structural Improvements (8 Bay North)	Lump Sum
800.703	Fire Protection and Structural Improvements (10 Bay and adjoining 4 Bay Storage)	Lump Sum
800.704	Fire Protection and Structural Improvements (10 Bay)	Lump Sum

SPECIAL PROVISIONSECTION 825WATER DISTRIBUTION PIPING825.01 Description

This section shall replace SECTION 625 of the State of Maine Department of Transportation Standard Specifications Revision of March 2020 for the purposes of this Contract.

This work shall consist of installing fire water mains, fire water services and accessories in reasonably close conformity with the lines and grades shown on the plans or established. The installation shall include the assembly of all components and materials shown on the plans or as directed.

The work in this Section shall also include the following:

- Furnishing and installation of pipe, valves, service boxes, fittings, hydrants and any required accessories for a complete water main loop.
- Connections to existing water systems.
- Setting service boxes and covers to finish grade.
- Disinfection and testing.

825.02 General

This work shall be done with as little interruption of water service as possible. Ample notification shall be given to the users of the water before any disruption of water service.

- A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
 - 1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.
 - 2. Protect threaded ends and flange faces against damage.
 - 3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.
- B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

- D. Deliver piping 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.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

825.03 Materials

Pipe

- A. Mechanical-Joint, Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 2. AWWA C104/A21.4 cement mortar-lined.
- B. Mechanical-Joint, Ductile-Iron Fittings:
 - 1. AWWA C110, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. PE, Fire-Service Pipe: ASTM F714, AWWA C906, or equivalent for PE Ductile Iron Pipe Size (DIPS) water pipe; FM Global approved, with minimum thickness equivalent to FM Global **Class 200**.
 - 1. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, and made to match PE pipe dimensions and class.

Gate Valves

- A. Gate Valves - AWWA, Cast Iron:
 - 1. Gate Valves - Nonrising Stem, Resilient Seated: Cast- or ductile-iron body and bonnet, with bronze or cast- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - a. Standards: AWWA C509 or AWWA C515.
 - b. Minimum Pressure Rating: 200 psig
 - c. End Connections: Mechanical joint, flanged, threaded, or push on.
 - d. Interior Coating: Complying with AWWA C550.

Valve Boxes

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

Fire Hydrants

- A. Fire Hydrants - Dry Barrel:
 - 1. Source Limitations: Obtain fire hydrants - dry barrel, from single manufacturer.
 - 2. Pressure Rating: 250 psig .
 - 3. Standard: AWWA C502.
 - 4. Freestanding configuration, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating in accordance with AWWA C550. Hydrant to have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - 5. Standards: UL 246, and FM Global approved.
 - a. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - b. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
 - c. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
 - d. Exterior Finish: Red alkyd-gloss enamel paint unless otherwise indicated.

- a. Installation

825.04 Water Main and Services

Care shall be exercised in placing and laying of services to prevent kinks or sharp bends and to prevent contact with sharp stones or ledge which would damage to the pipe. At least 6 inches of sand shall be placed adjacent to, under, and above the pipe, and no stone larger than 2 inches shall be placed over the pipe until the depth of backfill above the pipe is in excess of 1 foot.

825.05 Separation from Structures

Whenever possible, water pipes shall maintain a minimum distance of four (4) feet from underground adjacent unheated structures, such as manholes, catch basins, retaining walls, bridge abutments, parking garages, etc.

When spacing described above is not possible, Contractor shall provide insulation for the water pipe for a minimum of four (4) feet beyond the limits of the adjacent structure.

b. Testing

Hydrostatic pressure and leakage test shall be conducted in accordance with AWWA Standard C600 Standards. Domestic water service lines without attached fire service supply shall meet the latest edition of AWWA C600 series leakage requirements for the type of pipe being installed. Testing shall be conducted by a certified independent water testing company.

c. Disinfection

Before being placed in service, all new water pipe shall be chlorinated in accordance with ANSI/AWWA C651 Standard for Disinfecting Water Mains.

The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be installed by the Contractor. The Contractor shall uncover and backfill the taps as required.

The pipe section being disinfected shall be flushed to remove discolored water and sediment from the pipe. A 25 mg/l chlorine solution in approved dosages shall be inserted through a tap at one end while water is being withdrawn at the other end of the pipe section. The chlorine concentration in the water in the pipe shall be maintained at a minimum 25 mg/l available chlorine during filling. To assure that this concentration is maintained, the chlorine residual shall be measured at regular intervals in accordance with procedures described in Standard Methods and AWWA M12, Simplified Procedure for Water Examination, Section K.

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the pipe supplying the water. Chlorine application shall not cease until the entire pipe section is filled with chlorine solution. The chlorinated water shall be retained in the pipe for at least a twenty-four hour period. The treated water shall contain a chlorine residual throughout the length of the pipe section as indicated in AWWA C651.

Following the chlorination period, all treated water shall be flushed from the pipe section and replaced with water from the distribution system. Prior to disposal of treated water, the Contractor shall check with local authorities to determine if the discharge will cause damage to the receiving body or sewer and, if required, the Contractor shall neutralize the chlorinated water in accordance with Appendix B, AWWA C650. Bacteriological sampling and analysis of the replacement water shall then be made by the Contractor in full accordance with AWWA Specification C651. A minimum of three samples shall be taken by the Contractor at locations directed by the Engineer along the length of water pipe being chlorinated and sent to a state- approved private laboratory for analyses. The Contractor shall re-chlorinate if the samples show presence of coliform, and the pipe section shall not be placed in service until all the repeat samples show no presence of coliform.

Furnish two (2) copies of a Certificate of Disinfection Report to the Engineer.

The Contractor shall pay all costs for all testing, flushing, chlorinating, laboratory analyses, sampling, water supply, and municipal charges.

825.06 Method of Measurement

Water main and service pipe measured by the linear foot installed, to the nearest foot.

825.07 Basis of Payment

The accepted quantity of water service supply lines will be paid for at the contract unit price, complete in place, which shall be full compensation for all materials, labor, and incidentals required to complete the work.

Excavation, backfill, bedding, compaction, sheeting and shoring, insulation, dewatering, restoration of existing service connections, curb stops, curb boxes, fittings, stainless steel inserts, insulation, thrust blocks, pressure testing, disinfection, flushing, maintaining water service, connections to existing water services, as-built drawings and any and all other work necessary or required for a complete operational fire water supply main and service shall be considered included in the work. Payment for final hot mix asphalt, loam, seed, recycled asphalt pavement, aggregate base course and aggregate subbase shall be under the appropriate pay item.

Payment will be made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
825.461 6 Inch HDPE DR 9 Plastic Main and Service	Linear Foot
825.601 6 Inch Ductile Iron Class 52 Pipe	Linear Foot
825.700 Fire Hydrant	Each

SPECIAL PROVISION

SECTION 832

SITE BOLLARDS

832.01 Description

This work shall consist of furnishing and installing Type A Steel Site Bollards consisting of a cast in place concrete base, 6" schedule 80 concrete-filled galvanized steel pipe, and plastic yellow sleeve in accordance with these specifications, and as shown on the Plans.

Shop drawings for the site bollards shall be completed, submitted to, and accepted by the Resident prior to any work being completed relative to this section.

832.02 Materials

Concrete shall be Class "B" concrete and shall meet the requirements of Section 502. Yellow vinyl sleeves are to be provided as noted on the plans or an approved equal.

832.03 Method of Measurement

Type A Steel Site Bollard will be measured for payment by each unit satisfactorily constructed, installed, and accepted. Excavation and concrete will not be measured for payment but shall be incidental to the work under this item.

832.04 Basis of Payment

All work under Section 832.41, Type A Steel Site Bollard, shall be paid for at the contract unit price per each, which shall be full compensation for all materials, labor, and incidentals

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
832.41 Type A Steel Site Bollard	Each

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sealer, hardener, and polishing for cast-in-place concrete and existing concrete.
- B. Related Documents:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. Aggregate Exposure Class: Visual observation of polished floor aggregate surface exposure area after grinding and polishing operations. Aggregate exposure class ranges are A, B, and C.
- B. Design Reference Sample: Sample designated by Architect that reflects acceptable surface quality and appearance of polished concrete.
- C. Distinctness of Image (DOI): The distinctness (clarity) of images reflected by the glossy coating surface appearance of the polished concrete finish appearance levels. The transmission of this reflection is measured in accordance with ASTM D5767.
- D. Haze: The cloudiness or milky appearance of images from objects produced by reflection in a polished concrete surface. The measurement of this appearance is defined in accordance with ASTM D4039. The test method reading is put into a calculation resulting in a Haze Index value.
- E. Specular Gloss: A reflectance value determined by a single measurement of gloss from shining a known amount of light at a surface within a specific angle of illumination in accordance with ASTM D523.

1.3 REFERENCES:

- A. ASTM International (ASTM)
 - 1. ASTM C799: 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.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Cast-in-place concrete subcontractor.
 - b. Polished concrete finishing subcontractor.
 - c. Architect.
 - d. Owner's representative.
2. Review concrete slab for flatness and levelness, cold- and hot-weather concreting procedures, curing procedures, sequencing, construction joints, concrete repair procedures, concrete finishing, polished concrete appearance and aggregate exposure requirements..
3. Inspect mock-up and review acceptable characteristics and sheen.
4. Review scheduled work to be conducted in space after floor finishing is completed. Review protection, cleaning and repair procedures.

1.5 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets for each type of product.
 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.
- B. Test Reports: Provide certified test reports, prepared by and independent testing laboratory, confirming compliance with specified performance criteria.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. An installer experienced in performing polished concrete finishing with a minimum of five previous projects similar in material, design, and extent to that indicated for this Project.
 2. Trained and certified by manufacturer of polished concrete system materials.
- B. Polished Concrete Standards: Comply with ACI 310.1.

1.7 MOCKUPS

- A. Build mockups Provide a mock-up for evaluation of workmanship and appearance to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, color

variation (if any) and tolerances. Build mockups of approximately a 4'x4' section to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location of the Work and of the size indicated, as directed by Architect for both newly placed and existing concrete.
2. Demonstrate surface preparation, coloring, curing, tested aggregate exposure, tested polish appearance, sealing and protecting of polished concrete.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Remove rejected mockups.

1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as needed for other construction activities.
- B. Ambient Conditions: Ensure installation location and Project ambient conditions comply with manufacturers' written instructions.

1.9 WARRANTY

- A. Provide manufacturers' 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.
- C. Slip Resistance: Minimum Dynamic Coefficient of Friction (DCOF) of 0.42. Provide required slip resistance based on final gloss level and determined by the Concrete Polishing Council.

2.3 ACCESSORIES

- A. Repair Materials: As recommended in writing by manufacturer to repair and fill cracks, and repair surfaces compatible with polishing materials.
- B. Neutralizing Agent: Tri-sodium phosphate.
- C. Water: Potable.
- D. Cleaning Agents: As recommended in writing by manufacturer.

2.4 POLISHING EQUIPMENT

- A. Equipment and Supplies: Provide equipment and supplies, not limited to, the concrete grinding and concrete polisher equipment, tooling and polishing diamonds for the polished concrete finishing Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that concrete substrates are acceptable for grinding, polishing and product installation as recommended by manufacturer.
- B. Do not begin Work until unsatisfactory conditions have been addressed and corrected.
- C. Prior to application, verify the floor surfaces are free of construction laitance.

3.2 PREPARATION

- A. Verify that concrete substrate preparation is in accordance with manufacturer's written instructions.
- B. 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 diapiered 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. Clean surfaces free of dust, dirt and other contaminates incompatible with liquids applied products and polishing.
- C. Clean and seal cracks as recommended by manufacturer.
- D. Prepare, clean and fill joints with joint filler as recommended in writing by manufacturer.
- E. Clean surface completely of any dust with cleaning solution as recommended in writing by manufacturer.

3.3 ENVIRONMENTAL LIMITATIONS

- A. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
 1. Concrete shall be cured a minimum of 45 days or as directed by the manufacturer before application can begin.
 2. Application shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.
- B. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer

3.4 APPLICATION

- A. Machine grind floor surfaces progressively to receive aggregate and polish appearance levels indicated to match approved mockup.
- B. Apply penetrating stain densifier treatment for polished concrete in polishing sequence and in accordance with manufacturer's written instructions, allowing recommended drying time between successive coats.
- C. Apply reactive color stain for polished concrete in polishing sequence and in accordance with manufacturer's written instructions.
- D. Apply color dyes for polished concrete in polishing sequence and in accordance with manufacturer's written instructions.

- E. Apply sealers to polished concrete in polishing sequence and in accordance with manufacturers' written instructions.
- F. Continue progressively polishing to aggregate and polish appearance levels to match approved mockup for final finish appearance.
- G. Visually inspect to remove defects and repolish areas that are defective. Repolish those areas that do not meet specified aggregate and polish levels per approved mockup.
- H. Follow manufacturer's installation instructions. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers
- I. Complete edges of floor finish that adjoins surrounding floor areas in a sharp and clean manner.
- J. Neutralize and clean polished floor surfaces.
- K. Achieve waterproofing, hardening, dust-proofing, and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
- L. Polish to required sheen level.

3.5 CLEANING AND PROTECTION

- A. Control and dispose of waste products produced by grinding and polishing operations.
- B. Remove debris from jobsite. Dispose of materials in separate, closed containers in accordance with local regulations.
- C. 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.
- D. Protect installed polished concrete surfaces from damage during construction in accordance with manufacturer's written instructions.

END OF SECTION 033543

SECTION 061000 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Dimension lumber framing.
4. Miscellaneous lumber.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.
 4. WCLIB: West Coast Lumber Inspection Bureau.
 5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 1. Boards: 15 percent.
 2. Dimension Lumber: 15 percent.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, use categories as follows:
 1. UC2: Interior construction not in contact with ground but may be subject to moisture. Include the following items:
 - a. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - c. Wood floor plates that are installed over concrete slabs-on-grade.

2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 4. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2 grade.
 1. Application: All interior partitions.
 2. Species:
 - a. Southern pine or mixed southern pine; SPIB.
 - b. Spruce-pine-fir; NLGA.
 - c. Hem-fir; WCLIB, or WWPA.
 - d. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - e. Northern species; NLGA.
 - f. Eastern softwoods; NeLMA.
- B. Load-Bearing Partitions by Grade: No. 1 or No. 2 grade.
 1. Application: interior load-bearing partitions.
 2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine or mixed southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB or WWPA.
 - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. Load-Bearing Partitions by Performance: Any species and grade with a modulus of elasticity of at least 1,400,000 psi and an extreme fiber stress in bending of at least 875 psi for 2-inch nominal thickness and 6-inch nominal width for single-member use.
 1. Application: interior load-bearing partitions.
- D. Ceiling Joists: No.1 or No. 2 grade.

1. Species:
 - a. Southern pine or mixed southern pine; SPIB.
 - b. Spruce-pine-fir; NLGA.
 - c. Hem-fir; WCLIB or WWPA.
 - d. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - e. Northern species; NLGA.
 - f. Eastern softwoods; NeLMA.

E. Joists, Rafters, and Other Framing by Grade: No. 1 or No. 2 grade.

1. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine or mixed southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB or WWPA.
 - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

F.

2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Furring.
- B. Dimension Lumber Items: No. 1 or No. 2 grade lumber of any of the following species:
 1. Mixed southern pine or southern pine; SPIB.
 2. Spruce-pine-fir; NLGA.
 3. Hem-fir; WCLIB or WWPA.
 4. Northern species; NLGA.
 5. Eastern softwoods; NeLMA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 or of Type 304 stainless steel.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

- J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.4 INSTALLATION OF WALL AND PARTITION FRAMING

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions only if indicated on drawings. Fasten plates to supporting construction unless otherwise indicated.
1. For interior partitions and walls, provide 2-by-6-inch nominal- and 2-by-4-inch nominal-size wood studs spaced 16 inches o.c. unless otherwise indicated.
 2. Provide continuous horizontal blocking at mid-height of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs.

- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated or, if not indicated, according to Table R502.5(1) or Table R502.5(2), as applicable, in ICC's International Residential Code for One- and Two-Family Dwellings.

3.5 INSTALLATION OF FLOOR JOIST FRAMING

- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
 - 1. Where supported on wood members, by using metal framing anchors.
 - 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.
- C. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches from top or bottom.
- D. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.
- E. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.
- F. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c., extending over and fastening to three joists. Embed anchors at least 4 inches into grouted masonry with ends bent at right angles and extending 4 inches beyond bend.
- G. Provide solid blocking between joists under jamb studs for openings.
- H. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
 - 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- I. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists unless otherwise indicated in drawings.

1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal- size lumber, double-crossed and nailed at both ends to joists.

END OF SECTION 061000

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

- B. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

- C. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
- D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below **40 deg F**.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect or Owner from manufacturer's full range.
- C. VOC Content: Verify sealants and sealant primers comply with the following:
 1. Architectural sealants have a VOC content of 250 g/L or less.
 2. Sealants and sealant primers for nonporous substrates have a VOC content of 250 g/L or less.
 3. Sealants and sealant primers for porous substrates have a VOC content of 775 g/L or less.

2.3 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability. nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT.

2.4 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

- C. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. The Dow Chemical Company.
 - b. Tremco Incorporated.

2.6 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.
- C. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Pecora Corporation.
 - b. Sherwin-Williams Company (The).
 - c. Tremco Incorporated.

2.7 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Pecora Corporation.
- b. Sherwin-Williams Company (The).
- c. Tremco Incorporated.

2.8 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Gypsum.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Acceptance Criteria: All installations are to be per manufacturer's standards. No adhesion failure will be acceptable, including but not limited, to cracking, peeling, or shrinkage. Any and all failure areas must be removed and re-applied.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage

or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 08 71 00 "Door Hardware"
2. Section 08 80 00 "Glazing" for glazing in doors for hollow metal doors

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

D. Shop Drawings: Include the following:

1. Elevations of each door.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 HOLLOW METAL DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. AMBICO.
 2. Ceco Door; AADG, Inc.; ASSA ABLOY.
 3. Clopay.

2.2 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.37 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule on Drawings.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.032 inch.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.042 inch.
 - b. Construction: Knocked down.
 - 3. Exposed Finish: Factory.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule on Drawings.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch (14 gauge), with minimum A60 coating.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: Manufacturer's standard.

2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (14 guage), with minimum A60 coating.
 - b. Construction: Knocked down.
3. Exposed Finish: Factory.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 - 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Floor Anchors: Secure with postinstalled expansion anchors.
 - 3. Solidly pack mineral-fiber insulation inside frames.
 - 4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

3.3 Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions

3.4 FIELD QUALITY CONTROL

A. Inspections:

1. Field inspect all doors to ensure finish, operation and quality meet this specification without any blemishes, defects or inoperable parts.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.5 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Larsen's Manufacturing Company.
2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Optional Features: Piano hinges. Hing side as indicated in the drawings.
4. Locations: Wall and Ceiling.
5. Door Size: as indicated (Ceiling access not smaller than 24x30).
6. Metallic-Coated, Powder Coated or baked enamel coted Steel Sheet for Door: Nominal 0.064 inch, 16 gage min., factory finished.
7. Frame Material: Same material, thickness, and finish as door.
8. Latch and Lock: Cam latch, screwdriver operated.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.
 - a. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- 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.

3.4 ADJUSTING

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

END OF SECTION 083113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Self-closing hinges and pivots.
3. Bored locks.
4. Mortise locks.
5. Electromechanical locks.
6. Lock cylinders.
7. Operating trim.
8. Surface closers.
9. Wall- and floor-mounted stops.
10. Door gasketing.
11. Thresholds.
12. Metal protective trim units.
13. Auxiliary electrified door hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames".

1.2 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Project site.

1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system, including, but not limited to, the following:
 - a. Preliminary key system schematic diagram.
 - b. Requirements for key control system.
 - c. Requirements for access control.
 - d. Address for delivery of keys.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Hinges.
2. Self-closing hinges and pivots.
3. Bored locks.
4. Mortise locks.
5. Electromechanical locks.
6. Lock cylinders.
7. Operating trim.
8. Surface closers.
9. Wall- and floor-mounted stops.
10. Door gasketing.
11. Thresholds.
12. Metal protective trim units.
13. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Product Data Submittals: For each product.

C. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

- D. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of product data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- E. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as a Door and Hardware Specification Consultant (DHSC) and an Electrified Hardware Consultant (EHC).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.

- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
- 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design", the DOT's "ADA Standards for Transportation Facilities", ICC A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 - 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

- A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.4 SELF-CLOSING HINGES AND PIVOTS

- A. Self-Closing Hinges and Pivots: ANSI/BHMA A156.17.

2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw:
 - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 - 3. Occupany indicator deadbolt throw with color coded indicator.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
 - 1. Levers: Cast.
 - 2. Escutcheons (Roses): Cast.
 - 3. Dummy Trim: Match lever lock trim and escutcheons.
- D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- E. Bored Locks: ANSI/BHMA A156.2, Grade 1, Series 4000.
- F. Mortise Locks: ANSI/BHMA A156.13, Operational Grade 1 ; stamped steel case with steel or brass parts; Series 1000.

2.6 ELECTROMECHANICAL LOCKS

- A. Electromechanical Locks: ANSI/BHMA A156.25, Grade 1; motor or solenoid driven; with strike that suits frame.
 - 1. Type: Mortise latchbolt.

2.7 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
- B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable.
- C. High-Security Lock Cylinders: ANSI/BHMA A156.30, Grade 1 permanent cores that are removable; face finished to match lockset.
 - 1. Type M, mechanical.
- D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.8 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
 - 1. Master Key System: Change keys and a master key operate cylinders.
 - a. Provide three cylinder change keys and five master keys.
 - 2. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 - 3. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE." Information to be furnished by Owner.

2.9 OPERATING TRIM

- A. Operating Trim: ANSI/BHMA A156.6; stainless steel unless otherwise indicated.

2.10 SURFACE CLOSERS

- A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 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. Allegion plc.
 - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - c. Hager Companies.
 - d. Yale Security Inc; ASSA ABLOY.
 - e. dormakaba USA Inc.

2.11 DOOR GASKETING

- A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
- B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg, as follows:
 - 1. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
 - 2. Gasketing on Double Doors: 0.50 cfm per ft. of door opening.

2.12 THRESHOLDS

- A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.

2.13 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

2.14 AUXILIARY ELECTRIFIED DOOR HARDWARE

- A. Auxiliary Electrified Door Hardware: ANSI/BHMA A156.35.

2.15 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.16 FINISHES

- A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- E. Key Control System:
 - 1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 - 2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
 - 3. Key Control System Software: Set up multiple-index system based on final keying schedule.
 - 4. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant is to examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service is to include 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SCHEDULE

- A. As indicated on A-602.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass products.
 - 2. Insulating glass.
 - 3. Glazing sealants.
 - 4. Glazing tapes.
 - 5. Miscellaneous glazing materials.
 - 6. Privacy Glazing Film
- B. Related Requirements:
 - 1. Section 088300 "Mirrors."

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

- C. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer manufacturers of fabricated glass units.
- B. Product Certificates: For glass.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.
- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Design Snow Loads: As indicated on Drawings.
 - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 - 4. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- D. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone as indicated on the drawings for basic protection.
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 - 2. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - 3. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.

4. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- 4.
5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

- B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT. Or manufacturer's recommended sealant to be approved by Architect.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 PRIVACY GLAZING FILM

- A. Privacy interior film application onto existing glazing.
- B. Thickness: 2 mil.
- C. Performance Level: Medium

- D. Finish: White matte, translucent.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
 - 1. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 - 1. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
 - 1. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and

glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Glass Type GL-1

1. Overall Unit Thickness: as required to meet performance requirements and door frame allowance.
2. Minimum Thickness of Each Glass Lite: as required to meet performance requirements.
3. Outdoor Lite: Fully tempered float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Fully tempered float glass.
6. Winter Nighttime U-Factor: .036 maximum.
7. Summer Daytime U-Factor: 0.37 maximum.
8. Safety glazing required.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silvered flat glass mirrors.

B. Related Requirements:

1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of mirror and mirror mastic.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- B. Source Limitations for Mirror Accessories: Obtain mirror-glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C1503.
- B. Annealed Monolithic Glass Mirrors: Mirror Glazing Quality Q1 clear.
 - 1. Nominal Thickness: 4.0 mm min.
- C. Safety Glazing Products: For film-backed mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
 - 1. Aluminum J-Channel Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - 2. Aluminum J-Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - 3. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

- A. Shop fabricate mirrors to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished.
 - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
- D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 - 1. NGA Publications: "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."
- B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
 - 2. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION 088300

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood framing substrate in gypsum board assemblies.
2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Mold-Resistant Gypsum ceiling board.
2. Mold-Resistant Gypsum board.
3. Interior trim.
4. Joint treatment materials.
5. Sound-attenuation blankets.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Mold-Resistant Gypsum Ceiling Board: ASTM C1396/C1396M.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.
- B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
 - h. Base-of-Wall Galvanized Moisture Barrier Trim: Galvanized-steel sheet, 2 inches high.
 - i. Base-of-Wall PVC Moisture Barrier Trim: Extruded PVC, 1-3/4 inch high.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 3 finish, use setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.
2. Ceiling Type: 1/2" mold resistant.
3. Mold-Resistant Type: Where indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing)
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints in accordance with ASTM C840 notify architect where control joints are planned prior to installing for approval.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. Bullnose Bead: Use at outside corners .

3.5 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 4: All interior exposed gypsum surfaces.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic-rubber base.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 3. Product Data: For sealants, indicating VOC content.
 - 4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Product Schedule: For resilient base and accessory products.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.

2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE RB-1

- A. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
1. Group: I (solid, homogeneous).
 2. Style and Location:
 - a. Style B, Cove: Provide in areas with concrete flooring.
- B. Thickness: 0.125 inch.
- C. Height: 6 inches.
- D. Lengths: Coils in manufacturer's standard length.
- E. Outside Corners: Preformed.
- F. Inside Corners: Preformed.
- G. Colors: Platinum.

2.2 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
1. Verify adhesives have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Accessories: Prepare horizontal surfaces according to ASTM F710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum RH percent relative humidity level measurement, as dictated by manufacturer.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.

- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096513

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
 - 1. Wood.
 - 2. Gypsum board.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content.
 - 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
 - 3. Environmental Product Declaration: For each product.
 - 4. Third-Party Certifications: For each product.

- 5. Third-Party Certified Life Cycle Assessment: For each product.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
- E. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Benjamin Moore & Co.
 - 2. California Paints; ICP Building Solutions Group.
 - 3. Sherwin-Williams Company (The).

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: For field applications inside the building, verify wall paints comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Interior Flat Latex Wall Paint: 50 g/L.
 - 2. Interior Nonflat Latex Wall Paint: 150 g/L.
- D. VOC Emissions: For field applications inside the building, verify wall paints contain no more than half of the chronic REL of VOCs when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.
- E. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent.

6. Plaster: 12 percent.

- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:

- a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Metal conduit.
2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Metal conduit.
 - e. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces: See 033543 FL "Polished Concrete Finishing"
- B. Steel Substrates not requiring fire rated coatings:

1. Water-Based Light-Industrial Coating System over Epoxy Primer System, MPI INT 5.1N:
 - a. Prime Coat: Primer, epoxy, anti-corrosive.
 - b. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light-industrial coating, interior, water based (MPI Gloss Level 3, or flat to match ceiling when painted).
 - 1) Doors and frames to have MPI Gloss Level 5: Semi-Gloss for cleanability
- C. Plastic Substrates:
 1. Water-Based Light Industrial Coating System, MPI INT 6.8C
 - a. Prime Coat: Primer, bonding, solvent based.
 - b. Intermediate Coat (premium grade): Light-industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light-industrial coating, interior, water based (MPI Gloss Level 3).
- D. ASJ Insulation-Covering Substrates: Including pipe and duct coverings
 1. Latex System, MPI INT 10.1A
 - a. Prime Coat: Primer sealer, latex, interior
 - b. Intermediate Coat (Premium grade): Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, (MPI Glass Level 3)
- E. Gypsum Board Substrates:
 1. Water-Based Light-Industrial Coating System, MPI INT 9.2L:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light-industrial coating, interior, water based (MPI Gloss Level 3).

END OF SECTION 099124

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Toilet-compartment occupancy-indicator system.
3. Under lavatory guards.
4. Custodial accessories.

B. Related Requirements:

1. Section 088300 "Mirrors" for frameless mirrors.

1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Public-use washroom accessories.
2. Toilet-compartment occupancy-indicator system.
3. Under lavatory guards.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

C. Samples: For each exposed product and for each finish specified, full size.

1. Approved full-size Samples will be returned and may be used in the Work.

- D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

- 1. Identify locations using room designations indicated.

- E. Delegated Design Submittals: For grab bars.

- 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Toilet-Compartment Occupancy-Indicator Systems: Manufacturer agrees to repair or replace toilet-compartment occupancy-indicator systems that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser: Provided and installed by Owner

- C. Paper Towel (Roll) Dispenser: Provided and installed by Owner
- D. Waste Receptacle: Provided and installed by Owner
- E. Soap Dispenser: Provided and installed by Owner
- F. Grab Bar:
 - 1. Mounting: Flanges with concealed fasteners.
 - 2. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 3. OD: 1-1/2 inches.
 - 4. Configuration and Length: As indicated on Drawings.
- G. Hook:
 - 1. Description: Single-prong unit.
 - 2. Mounting: Concealed.
 - 3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.3 TOILET-COMPARTMENT OCCUPANCY-INDICATOR SYSTEM

- A. Toilet-Compartment Occupancy-Indicator System: See door hardware.

2.4 UNDERLAVATORY GUARDS

- A. Under lavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.5 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.
- B. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- C. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The scope of work for the project includes designing and providing new wet pipe automatic suppression systems throughout the existing 8 bay north and south, and 10 bay garages, and dry pipe automatic sprinkler systems throughout the attic of the existing 8 bay north and south, and 10 bay garages. Provide complete sprinkler systems, including system piping, valves, sprinklers, hangers, trim, and appurtenances compliant with the applicable codes and standards. Provide a supervised backflow preventer upstream of the existing sprinkler system riser.

- B. Applicable Codes and Standards:

MUBEC (2025): Maine Uniform Building and Energy Code

International Code Council Codes:

IBC (2021): International Building Code

IEBC (2021): International Existing Building Code

National Fire Protection Association Standards:

NFPA 1 (2018): Fire Code

NFPA 4 (2024): Standard for Integrated Fire Protection and Life Safety System Testing

NFPA 13 (2016): Standard for The Installation of Sprinkler Systems

NFPA 22 (2013): Standard for Water Tanks for Private Fire Protection

NFPA 24 (2013): Standard for The Installation of Private Fire Service Mains and Their Appurtenances

NFPA 25 (2014): Standards for The Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

NFPA 70 (2023): National Electrical Code

NFPA 72 (2019): National Fire Alarm and Signaling Code

NFPA 101 (2018): Life Safety Code

NFPA 170 (2024): Standard for Fire Safety and Emergency Symbols

NFPA 241 (2019): Standard for Safeguarding Construction, Alteration, And Demolition Operations

NFPA 291 (2025): Recommended Practice for Water Flow Testing and Marking of Hydrants

- C. Section Includes:

1. Steel pipe and fittings.
2. Specialty valves.
3. Air vent.

4. Sprinkler piping specialties.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gauges.

D. Related Requirements:

1. Section 825 "Water Mains and Services" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of **175-psig (1200-kPa)** maximum.

1.3 ACTION SUBMITTALS

Approved Permit Submittal. Secure and pay any fees and obtain state and local permits pertaining to the contract.

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Include hydraulic calculations based on NFPA 291 hydrant flow test performed within 12 months prior to hydraulic calculations submission.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.

- B. Qualification Data: For qualified Designer, Installer, **and NICET certified technician**. Qualifications must be provided prior to approval of shop drawings.

- C. Design Data: Approved sprinkler piping working plans, prepared according to NFPA 13, including documented approval by authorities having jurisdiction, and including hydraulic calculations if applicable.

D. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
2. NFPA 291 Fire-hydrant flow test report performed within 12 months prior to hydraulic calculations and shop drawings submittal.

E. Field quality-control reports.

F. As-Built Drawings

1.5 CLOSEOUT SUBMITTALS

- A. Inspection, Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spares of each sprinkler type installed plus a sprinkler wrench. Include number of sprinklers required by NFPA 13. Include list of sprinklers, sprinkler identification numbers, model, orifice size, deflector type, thermal sensitivity, pressure rating, quantities, and issue date of sprinkler list.

1.7 QUALITY ASSURANCE

- A. Designer Qualifications:

1. Maine licensed sprinkler contractor, responsible managing supervisor, sprinkler designer, or a licensed fire protection engineer, either on staff or engaged by the contractor. Sprinkler designer must be minimum NICET Level III. The designer must provide professional engineering services needed to assume engineering responsibility.

- B. Installer Qualifications:

1. Installer's responsibilities include fabricating and installing sprinkler systems.
 - a. Installer must be **NICET Level II-certified technician, "Water-Based Systems Layout."**

1.8 FIELD CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify **Owner** no fewer than **two** days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without **Owner's** written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Sprinkler system equipment, specialties, accessories, installation, and testing to comply with **NFPA 13**.
- C. Standard-Pressure Piping System Component: Listed for **175-psig (1200-kPa)** minimum working pressure.
- D. High-Pressure Piping System Component: Listed for **250-psig (1725-kPa)** minimum working pressure.
- E. Design wet pipe sprinkler system to the applicable codes and standards.
 - 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: 10-Oct-2025.
 - b. Time: 9:30**a.m.**
 - c. Performed by: Colby Co. Engineering.
 - d. Location of Residual Fire Hydrant R: Hydrant 1-88 (South of Fletcher St.).
 - e. Static Pressure at Residual Fire Hydrant R: 60 psig.
 - f. Residual Pressure at Residual Fire Hydrant R: 34 **psig**.
 - g. Location of Flow Fire Hydrant F: Hydrant 1-178 (Fletcher St.).
 - h. Measured Flow at Flow Fire Hydrant F: 1,303 **gpm**.
 - i. Location of Flow Fire Hydrant F: Hydrant 1-87.2 (Fletcher St.).
 - j. Measured Flow at Flow Fire Hydrant F: 1,407 **gpm**.
 - 2. Margin of Safety for Available Water Flow and Pressure: **10** percent, including losses through water-service piping, valves, and backflow preventers.
 - 3. Sprinkler Occupancy Hazard Classifications:
 - a. Garages: **Ordinary Hazard, Group 2**.
 - b. Restrooms: **Light Hazard**.

4. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: **0.10 gpm/sq. ft. over 1500 sq. ft.**
 - b. Ordinary-Hazard, Group 2 Occupancy: **0.20 gpm/sq. ft. over 1500 sq. ft.**
5. Maximum protection area per sprinkler according to UL listing.
6. Maximum Protection Area per Sprinkler:
 - a. Restrooms: **225 sq. ft.**
 - b. Garages: **130 sq. ft.**
 - c. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- F. Obtain documented approval of sprinkler system design from authorities having jurisdiction.

2.2 STEEL PIPE AND FITTINGS

- A. All sprinkler piping shall be painted to match adjacent finishes.
- B. Standard-Weight Steel Pipe: **black**-steel pipe, ASTM A53/A53M, **Type E, Grade B**. Pipe ends may be factory or field formed to match joining method.
- C. Schedule 30 Steel Pipe: **black**-steel pipe, ASTM A135/A135M; ASTM A795/A795M. Pipe ends may be factory or field formed to match grooved joining method.
- D. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 plain end.
- E. Steel Pipe Nipples: **black** steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- F. Steel Couplings: steel, ASTM A865/A865M, threaded.
- G. Gray-Iron Threaded Fittings: gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
- H. Malleable- or Ductile-Iron Unions: UL 860.
- I. Cast-Iron Flanges: ASME 16.1, Class 125.
- J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 1. Pipe-Flange Gasket Materials: **AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.**
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

- K. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
 - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- L. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, **175-psig (1200-kPa)** pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.3 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: **175-psig (1200-kPa)** minimum.
 - 2. High-Pressure Piping Specialty Valves: **300-psig (2070-kPa)**.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
 - 1. Standard: UL 193.
 - 2. Design: For horizontal or vertical installation.
 - 3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, and fill-line attachment with strainer.
 - 4. Drip cup assembly pipe drain **with check valve to main drain piping**.
 - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Automatic (Ball Drip) Drain Valves:
 - 1. Standard: UL 1726.
 - 2. Pressure Rating: **175-psig (1200-kPa)** minimum.
 - 3. Type: Automatic draining, ball check.
 - 4. Size: **NPS 3/4 (DN 20)**.
 - 5. End Connections: Threaded.

2.4 AIR VENT

- A. Automatic Air Vent:
 - 1. Description: Automatic air vent that automatically vents trapped air without human intervention.
 - 2. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler systems.
 - 3. Vents oxygen continuously from system.

4. Float valve to prevent water discharge.
5. Minimum Water Working Pressure Rating: **175 psig (1207 kPa)**.

2.5 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 1. Standard: UL 213.
 2. Pressure Rating: **175-psig (1200-kPa) minimum**.
 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 4. Type: Mechanical-tee and -cross fittings.
 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 2. Pressure Rating: **175-psig (1200-kPa) minimum**.
 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 4. Size: Same as connected piping.
 5. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
 1. Standard: UL 199.
 2. Pressure Rating: **175 psig (1200 kPa)**.
 3. Body Material: Brass.
 4. Size: Same as connected piping.
 5. Inlet: Threaded.
 6. Drain Outlet: Threaded and capped.
 7. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 2. Pressure Rating: **175-psig (1200-kPa) minimum**.
 3. Body Material: Cast- or ductile-iron housing with sight glass.
 4. Size: Same as connected piping.
 5. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
 1. Standard: UL 1474.
 2. Pressure Rating: **250-psig (1725-kPa) minimum**.
 3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 4. Size: Same as connected piping.
 5. Length: Adjustable.
 6. Inlet and Outlet: Threaded.

2.6 SPRINKLERS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pendant sprinklers with a minimum k-factor of 8.0 shall be used. Where sprinklers must be installed in proximity to heat sources, provide temperature rating and spacing in accordance with NFPA 13, section 9.4.2.5. Coordinate sprinkler installation with location and temperature rating of unit heaters.
- C. Pressure Rating for Automatic Sprinklers: **175-psig (1200-kPa)** minimum.
- D. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: **UL 199**.
 - 2. Characteristics: Nominal **1/2-inch (12.7-mm)** orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- E. Sprinkler Finishes: **Chrome plated**.
- F. Special Coatings: **corrosion-resistant paint**.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: **Chrome-plated steel, one piece, flat**

2.7 BACKFLOW PREVENTERS

- A. Backflow Preventers - Double-Check Assembly:
 - 1. Source Limitations: Obtain backflow preventers - double-check assembly, from single manufacturer.
 - 2. Standard: **ASSE 1015**.
 - 3. Operation: Continuous-pressure applications unless otherwise indicated.
 - 4. Pressure Loss: **9 psig (35 kPa)** maximum, through middle one-third of flow range.
 - 5. Size: **6 NPS (DN)**.
 - 6. Body: **stainless steel** for **NPS 2-1/2 (DN 65)** and larger.
 - 7. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; grooved for **NPS 2-1/2 (DN 65)** and larger.
 - 8. Configuration: Designed for vertical flow.
 - 9. Accessories: Ball valves with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate valves with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.

2.8 ALARM DEVICES

- A. Alarm-device types to match piping and equipment connections.

B. Electrically Operated Notification Appliances:

1. Electric Bell:

- a. Standard: UL 464.
- b. Type: Vibrating, metal alarm bell.
- c. Size: **6-inch (150-mm) minimum**-diameter.
- d. Voltage: **120 V ac, 60 Hz, 1 phase**.
- e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

2. Strobe/Horn:

- a. Standard: UL 464.
- b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
- c. Voltage: 120 V ac, 60 Hz.
- d. Effective Intensity: 110 cd.
- e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
- f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police, or fire department.

C. Water-Flow Indicators:

- 1. Standard: UL 346.
- 2. Water-Flow Detector: Electrically supervised.
- 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 4. Type: Paddle operated.
- 5. Pressure Rating: **250 psig (1725 kPa)**.
- 6. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

- 1. Standard: UL 346.
- 2. Type: Electrically supervised.
- 3. Components: Single-pole, double-throw switch with normally closed contacts.
- 4. Design: Signals that controlled valve is in other than fully open position.
- 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.9 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
 - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
 - 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Panel Components:
 - 1. Power supply.
 - 2. Battery charger.
 - 3. Standby batteries.
 - 4. Field-wiring terminal strip.
 - 5. Electrically supervised solenoid valves and polarized fire-alarm bell.
 - 6. Lamp test facility.
 - 7. Single-pole, double-throw auxiliary alarm contacts.
 - 8. Rectifier.

2.10 FIRE-DEPARTMENT CONNECTION

- A. Standard: UL 405.
- B. Type: 5-inch Storz connection in accordance with Kennebunk Fire Department. Exposed, projecting, for wall mounting.
- C. Pressure Rating: **175 psig (1200 kPa)** minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Round, brass, wall type.
- H. Outlet: Back, with pipe threads.
- I. Finish: **Polished chrome plated.**
- J. Outlet Size: **NPS 5 (DN 125).**

2.11 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- C. Pressure Gauge Range: 0- to 250-psig (0- to 1725-kPa) minimum.
- D. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Content includes water-distribution piping and related components outside the building for **fire-suppression water service and terminated 5 ft. (1.5 m) from building and service entrance piping to a point 1 ft. (0.3 m) above finished floor**. Terminate water-service piping with appropriate fitting for extension by **Divisions 21 and 22**.
- B. Install shutoff valve, check valve, pressure gauge, and drain at connection to water service.

3.3 INSTALLATION OF BACKFLOW PREVENTERS

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install in accordance with requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support **NPS 2-1/2 (DN 65)** and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.4 INSTALLATION OF PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
 - C. Project is seismic design category B, seismic restraints on piping are not required. Comply with NFPA 13 requirements for hanger device materials and installation.
 - D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
 - E. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
 - F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
 - G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
 - H. Install sprinkler piping with drains for complete system drainage.
 - I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
 - J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
 - K. Install alarm devices in piping systems.
 - L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
 - M. Install pressure gauges on riser or feed main, at each sprinkler test connection. Include pressure gauges with connection not less than **NPS 1/4 (DN 8)** and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
 - N. Fill sprinkler system piping with water.

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

- B. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join [**lightwall**] [**and**] [**Schedule 5**] steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 for supports.

3.7 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
- E. Air Vent:
 - 1. Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
 - 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
 - 3. Pipe from outlet of air vent to drain.

3.8 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Wet system must only be installed in areas which are not subject to temperatures below 40°F

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 DEMONSTRATION

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

3.13 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with **threaded ends, and threaded joints**.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:
 - 1. **Schedule 30**, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:

1. **Schedule 30**, black-steel pipe with grooved ends; uncoated, gray-iron grooved fittings; and grooved joints.
- E. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:
 1. **Schedule 30**, black-steel pipe with grooved ends; uncoated, gray-iron grooved fittings; and grooved joints.

3.14 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Spaces Subject to Freezing: **Upright dry sprinklers**.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 1. Pendent Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The scope of work for the project includes designing and providing new wet pipe automatic suppression systems throughout the existing 8 bay north and south, and 10 bay garages, and dry pipe automatic sprinkler systems throughout the attic of the existing 8 bay north and south, and 10 bay garages. Provide complete sprinkler systems, including system piping, valves, sprinklers, hangers, trim, and appurtenances compliant with the applicable codes and standards. Provide a supervised backflow preventer upstream of the existing sprinkler system riser

- B. Applicable Codes and Standards:

MUBEC (2025): Maine Uniform Building and Energy Code

International Code Council Codes:

IBC (2021): International Building Code

IEBC (2021): International Existing Building Code

National Fire Protection Association Standards:

NFPA 1 (2018): Fire Code

NFPA 4 (2024): Standard for Integrated Fire Protection and Life Safety System Testing

NFPA 13 (2016): Standard for The Installation of Sprinkler Systems

NFPA 22 (2013): Standard for Water Tanks for Private Fire Protection

NFPA 24 (2013): Standard for The Installation of Private Fire Service Mains and Their Appurtenances

NFPA 25 (2014): Standards for The Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

NFPA 70 (2023): National Electrical Code

NFPA 72 (2019): National Fire Alarm and Signaling Code

NFPA 101 (2018): Life Safety Code

NFPA 170 (2024): Standard for Fire Safety and Emergency Symbols

NFPA 241 (2019): Standard for Safeguarding Construction, Alteration, And Demolition Operations

NFPA 291 (2025): Recommended Practice for Water Flow Testing and Marking of Hydrants

- C. Section Includes:

1. Steel pipe and fittings.
2. Specialty valves.
3. Dry-sprinkler system vapor corrosion inhibitor.
4. Sprinkler piping specialties.

5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gauges.

D. Related Sections:

1. 211313 – Wet Pipe Sprinkler Systems

1.2 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig (1200-kPa) maximum.

1.3 ACTION SUBMITTALS

- A. Approved Permit Submittal. Secure and pay any fees and obtain state and local permits pertaining to the contract.
- B. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For dry-pipe sprinkler systems.
1. Include plans, elevations, sections, and attachment details.
 2. Include diagrams for power, signal, and control wiring.
 3. Include hydraulic calculations based on NFPA 291 hydrant flow test performed within 12 months prior to hydraulic calculations submission.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinate with all building trades.
1. Domestic water piping.
 2. Compressed air piping.
 3. HVAC hydronic piping.
 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- B. Qualification Data: For qualified Designer, Installer, and NICET certified technician. Qualifications must be provided prior to approval of shop drawings.

- C. Design Data: Approved sprinkler piping working plans, prepared according to NFPA 13, including documented approval by authorities having jurisdiction, and including hydraulic calculations if applicable.
- D. Field Test Reports:
 - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - 2. NFPA 291 Fire-hydrant flow test report performed within 12 months prior to hydraulic calculations and shop drawings submittal.
- E. Field quality-control reports.
- F. As-Built Drawings

1.5 CLOSEOUT SUBMITTALS

- A. Inspection, Operation, and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spares of each type of sprinkler installed plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include list of sprinklers, sprinkler identification numbers, model, orifice size, deflector type, thermal sensitivity, pressure rating, quantities, and issue date of sprinkler list.
 - 2. Vapor Corrosion Inhibitor Replacement Cartridges: Provide two years of replacement cartridges based on the manufacturers recommended replacement schedule. Provided spares must not have expiration dates prior to the expected end of service date for the last of the two year supply of spare cartridges.

1.7 QUALITY ASSURANCE

- A. Designer Qualifications:
 - 1. Maine licensed sprinkler contractor, responsible managing supervisor, sprinkler designer, or a licensed fire protection engineer, either on staff or engaged by the contractor. Sprinkler designer must be minimum NICET Level III. The designer must provide professional engineering services needed to assume engineering responsibility.
- B. Installer Qualifications:

1. Installer's responsibilities include fabricating and installing sprinkler systems.
 - a. Installer must be a minimum NICET Level II-certified technician, "Water-Based Systems Layout."

1.8 FIELD CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
 2. Do not proceed with interruption of sprinkler service without Owner's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air or nitrogen. Opening of sprinklers releases compressed air or nitrogen and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Sprinkler system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.
- C. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- D. Design dry pipe sprinkler system to the applicable codes and standards
 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: 10-Oct-2025.
 - b. Time: 9:30a.m.
 - c. Performed by: Colby Co. Engineering.
 - d. Location of Residual Fire Hydrant R: Hydrant 1-88 (South of Fletcher St.).
 - e. Static Pressure at Residual Fire Hydrant R: 60 psig.
 - f. Residual Pressure at Residual Fire Hydrant R: 34 psig.
 - g. Location of Flow Fire Hydrant F: Hydrant 1-178 (Fletcher St.).

- h. Measured Flow at Flow Fire Hydrant F: 1,303 **gpm**.
 - i. Location of Flow Fire Hydrant F: Hydrant 1-87.2 (Fletcher St.).
 - j. Measured Flow at Flow Fire Hydrant F: 1,407 **gpm**.
- 2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 3. Sprinkler Occupancy Hazard Classifications:
 - a. Garages: **Ordinary Hazard, Group 2**.
 - b. Attic: **Light Hazard**.
 - 4. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: **0.10 gpm/sq. ft. over 1500 sq. ft.**
 - b. Ordinary-Hazard, Group 2 Occupancy: **0.20 gpm/sq. ft. over 1500 sq. ft.**
 - c. As indicated on plans and required by NFPA 13.
 - 5. Maximum protection area per sprinkler according to UL listing.
 - 6. Maximum Protection Area per Sprinkler:
 - a. Restrooms: **225 sq. ft.**
 - b. Garages: **130 sq. ft.**
 - c. According to NFPA 13 recommendations unless otherwise indicated.
 - 7. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: **100 gpm** for 30 minutes.
 - b. Ordinary-Hazard Occupancies: **250 gpm** for 60 minutes.
- E. Obtain required State and Local permits at contractor expense and provide documented approval of sprinkler system design from authorities having jurisdiction.

2.3 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Black-Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized-Steel Couplings: ASTM A865/A865M, threaded.
- E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME B16.1, Class 125.
- H. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Pressure Rating: 175-psig minimum.
 - 2. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
 - 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 DRY-SPRINKLER SYSTEM VAPOR CORROSION INHIBITOR (VCI)

- A. Description: Vapor corrosion inhibitor (VCI) delivery system to serve dry sprinkler zones for piping corrosion mitigation. System is to introduce corrosion-inhibiting vapor into the sprinkler piping network to form a monomolecular protective layer on internal pipe surfaces. System is to operate in conjunction with the system air compressor or air maintenance device.
- B. Standards:
 - 1. NFPA 13
 - 2. UL listed for use in fire protection systems
- C. VCI Delivery Unit:
 - 1. Wall-mounted or riser-mounted delivery unit sized to treat the total volume of the designated sprinkler system zone.
 - 2. Power: 120 VAC or 24 VDC as required by manufacturer.
 - 3. Injection Method: Automated monitoring and injection cycle to maintain required inhibitor concentration levels without interfering with system supervisory pressure.
 - 4. Fail-Safe: Unit shall not obstruct the flow of water or operation of the dry pipe valve during a fire event.
- D. Inhibitor Consumable:
 - 1. Type: Amine-carboxylate based or similar proprietary volatile chemistry.
 - 2. Compatibility: Chemically compatible with all system components including steel piping, copper, ductile iron, and elastomeric gaskets.
 - 3. Environmental: Non-toxic and environmentally safe for discharge.
 - 4. Sized for application to provide continuous protection for a minimum duration as recommended by manufacturer (typically 1 to 5 years) before refill or replacement is required.
- E. Monitoring and Indication:

1. Visual indication of power status and active injection.
2. Low-level or replacement-needed alarm/indicator for inhibitor chemical.
3. Dry contacts for remote monitoring of system trouble or chemical depletion status.

2.5 SPRINKLER PIPING SPECIALTIES

- A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.
- B. Branch Outlet Fittings:
 1. Standard: UL 213.
 2. Pressure Rating: 175-psig minimum.
 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 4. Type: Mechanical-tee and -cross fittings.
 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- C. Flow Detection and Test Assemblies:
 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 2. Pressure Rating: 175-psig minimum.
 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 4. Size: Same as connected piping.
 5. Inlet and Outlet: Threaded.
- D. Branch Line Testers:
 1. Standard: UL 199.
 2. Pressure Rating: 175-psig (1200-kPa) minimum.
 3. Body Material: Brass.
 4. Size: Same as connected piping.
 5. Inlet: Threaded.
 6. Drain Outlet: Threaded and capped.
 7. Branch Outlet: Threaded, for sprinkler.
- E. Sprinkler Inspector's Test Fittings:
 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 2. Pressure Rating: 175-psig minimum.
 3. Body Material: Cast- or ductile-iron housing with sight glass.
 4. Size: Same as connected piping.
 5. Inlet and Outlet: Threaded.

2.6 SPRINKLERS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Attic areas
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
4. Quick response type

D. Sprinkler Finishes: Chrome plated.

2.7 ALARM DEVICES

A. Pressure Switches:

1. Standard: UL 346.
2. Type: Electrically supervised water-flow switch with retard feature.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design Operation: Rising pressure signals water flow.

2.8 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- C. Pressure Gauge Range: 0- to 250-psig (0- to 1725-kPa) minimum.
- D. Label: Include "WATER" or "AIR/WATER" label on dial face.
- E. Air System Piping Gauge: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Comply with requirements for service-entrance piping and backflow preventers in Section 211313 "Wet Pipe Sprinkler Systems".

3.3 INSTALLATION OF PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Project is seismic design category B, seismic restraints on piping are not required. Comply with NFPA 13 requirements for hanger device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
 - 1. Pressure gauges and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13.
- O. Install pressure gauges on riser or feed main, at each sprinkler test connection. Include pressure gauges with connection not less than **NPS 1/4 (DN 8)** and with soft-metal seated globe valve,

arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

- P. Drain dry-pipe sprinkler piping.
- Q. Pressurize and check dry-pipe sprinkler system piping and air compressors.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

- J. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air-supply piping.
 - b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
 - c. Install compressed-air-supply piping from building's compressed-air piping system.

3.6 INSTALLATION OF SPRINKLERS

- A. Do not install pendent or sidewall sprinklers in areas subject to freezing.

3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

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

3.11 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:

1. Schedule 30, Black-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- E. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:
 1. Schedule 30, Black-steel pipe with grooved ends; galvanized, gray-iron grooved fittings; and grooved joints.
- F. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 5 and NPS 6 (DN 125 and DN 150), to Be One of the Following:
 1. Schedule 30, Black-steel pipe with grooved ends; galvanized, gray-iron grooved fittings; and grooved joints.

3.12 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Rooms without Ceilings: Upright sprinklers.
 2. Spaces Subject to Freezing: Upright Dry sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 1. Semi-Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 2. Upright Sprinklers: Rough bronze in unfinished spaces not exposed to view

END OF SECTION 211316

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Packless expansion joints.
 - 2. Alignment guides and anchors.
 - 3. Sleeves without waterstop.
 - 4. Sleeves with waterstop.
 - 5. Sleeve-seal systems.
 - 6. Grout.
 - 7. Silicone sealants.
 - 8. Escutcheons.
 - 9. Thermometers, liquid in glass, lead free.
 - 10. Thermowells, lead free.
 - 11. Pressure gauges, dial type, lead free.
 - 12. Gauge attachments, lead free.

1.2 ACTION SUBMITTALS

- A. Product data.
- B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.6 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 SLEEVES AND SLEEVE SEALS

- A. Sleeves without Waterstop:
 - 1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
 - 2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
 - 3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge (0.6 mm) minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
- B. Sleeves with Waterstop:

1. Description: Manufactured PVC/HDPE, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Sleeve-Seal Systems:

1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - a. Hydrostatic Seal: 20 psig (137 kPa) minimum.
 - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - c. Pressure Plates: Carbon steel.
 - d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 of length required to secure pressure plates to sealing elements.

D. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

E. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
2. Silicone Sealant, S, P, T, NT: Single-component, 100/50, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
 - a. Standard: ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.

2.3 ESCUTCHEONS

A. Escutcheon Types:

1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
2. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

B. Floor Plates:

1. Split Floor Plates: Cast brass with concealed hinge.

2.4 METERS AND GAUGES FOR PLUMBING PIPING

- A. Thermometers, Liquid in Glass, Lead Free - Metal Case, Industrial Style:
1. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, industrial-style thermometers from single manufacturer.
 2. Standard: ASME B40.200.
 3. Case: Cast aluminum; 7-inch (180-mm) nominal size unless otherwise indicated.
 4. Case Form: Straight unless otherwise indicated.
 5. Tube: Glass with magnifying lens and blue or red organic liquid, mercury free.
 6. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F (deg C).
 7. Window: Safety glass or acrylic plastic.
 8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 10. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- B. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:
1. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
 2. Standard: ASME B40.100.
 3. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch (115-mm) nominal diameter.
 4. Pressure-Element Assembly: Lead-free Bourdon tube.
 5. Pressure Connection: Lead-free brass, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi (kPa).
 8. Pointer: Dark-colored metal.
 9. Window: Safety glass or plastic.
 10. Ring: Metal.
 11. Accuracy: Grade C, plus or minus 3 percent of middle half of span.
- C. Gauge Attachments, Lead Free:
1. Snubbers: ASME B40.100, lead-free brass; with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and-type surge-dampening device. Include extension for use on insulated piping.
 2. Valves: Lead-free brass ball, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS, GENERAL

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
 - 3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.3 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 2. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

3.4 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.6 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.7 INSTALLATION OF METERS AND GAUGES

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.

- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- H. Install valve and snubber in piping for each pressure gauge for fluids.
- I. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- J. Install pressure gauges in the following locations:
 - 1. Building water service entrance into building.

3.8 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.9 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.10 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
 - 2. Prepare test and inspection reports.
- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.11 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops.
4. Interior Wall and Partitions:
 - a. Sleeves without waterstops.

3.12 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Existing Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated finish.
 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 4. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment-room floors.
- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 1. New Piping: One piece, floor plate.
 2. Existing Piping: Split floor plate.

3.13 THERMOMETER, LEAD FREE, APPLICATION

- A. Thermometers at inlet and outlet of each domestic water heater are to be the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Metal case, industrial-style, liquid-in-glass type.
- B. Thermometer stems are to be of length to match thermowell insertion length.

3.14 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

- A. Scale Range for Domestic Cold-Water Piping:
 - 1. 30 to 240 deg F (0 to plus 115 deg C).
- B. Scale Range for Domestic Hot-Water Piping:
 - 1. 30 to 240 deg F (0 to plus 115 deg C).

3.15 PRESSURE-GAUGE APPLICATION

- A. Pressure gauges at discharge of each water service into building are to be the following:
 - 1. Sealed, direct mounted, metal case.
 - 2. Sealed, direct mounted, plastic case.
 - 3. Test plug with EPDM self-sealing rubber inserts.

3.16 PRESSURE-GAUGE SCALE-RANGE APPLICATION

- A. Scale Range for Water Service Piping:
 - 1. 0 to 100 psi (0 to 600 kPa).
- B. Scale Range for Domestic Water Piping:
 - 1. 0 to 100 psi (0 to 600 kPa).

END OF SECTION 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Check valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. FKM: Fluoroelastomer.
- D. NBR: Nitrile butadiene rubber (also known as Buna-N).
- E. NRS: Nonrising stem.
- F. OS&Y: Outside screw and yoke.
- G. PTFE: Polytetrafluoroethylene.
- H. RPTFE: Reinforced polytetrafluoroethylene.
- I. RS: Rising stem.

1.3 ACTION SUBMITTALS

- A. Product data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance

with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast-copper solder-joint connections.
6. ASME B16.22 for wrought-copper solder-joint connections.
7. ASME B16.34 for flanged- and threaded-end connections.
8. ASME B16.51 for press joint connections.
9. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Valve Actuator Type:

1. Hand Lever: For quarter-turn ball valves smaller than NPS 4 (DN 100).

I. Valves in Insulated Piping:

1. Provide 2-inch (50-mm) extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.2 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded Ends - Brass, One Piece:

1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 400 psig (2760 kPa).
3. Body Design: One piece.
4. Body Material: Forged brass or bronze.
5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Brass or stainless steel.

- 8. Ball: Chrome-plated brass or stainless steel.
- 9. Port: Reduced.

B. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Brass Trim:

- 1. Standards: MSS SP-110, MSS SP-145, IAPMO/ANSI Z1157.
- 2. CWP Rating: Minimum 200 psig (1380 kPa).
- 3. Body Design: Two piece.
- 4. Body Material: Forged brass.
- 5. Ends: Press.
- 6. Press-End Connections Rating: Minimum 200 psig (1380 kPa).
- 7. Seats: PTFE or RPTFE.
- 8. Stem: Brass.
- 9. Ball: Chrome-plated brass.
- 10. Port: Full.
- 11. O-Ring Seal: NBR or EPDM.

2.3 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 125:

- 1. Standard: MSS SP-80, Type 4.
- 2. CWP Rating: 200 psig (1380 kPa).
- 3. Body Design: Horizontal flow.
- 4. Body Material: ASTM B62, bronze.
- 5. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
- 6. Disc: PTFE.

B. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:

- 1. Standards: MSS SP-80 and MSS SP-139.
- 2. CWP Rating: Minimum 200 psig (1380 kPa).
- 3. Body Design: Horizontal flow.
- 4. Body Material: ASTM B584, bronze.
- 5. Ends: Press.
- 6. Press-End Connections Rating: Minimum 200 psig (1380 kPa).
- 7. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and actuator or manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Install check valves for proper direction of flow and as follows:
 - 1. Check Valves, Swing Type: In horizontal position with hinge pin level.
- I. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.

3.3 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Ball valves, lead free, threaded ends - brass, one piece.
 - 2. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and brass trim; threaded or soldered ends.

3.4 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded or soldered ends.
 - 2. Check valves, lead free, swing type, press ends - bronze.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports - metal.
2. Pipe hangers - metal, trapeze type.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe-positioning systems.
6. Equipment supports.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing" for pipe guides and anchors.
2. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ##### A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- ##### B. Structural Performance: Hangers and supports for plumbing piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 PIPE HANGERS AND SUPPORTS - METAL

A. Pipe Hangers and Supports - Carbon Steel:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**carbon steel**] [**stainless steel**] <Insert material>.

B. Pipe/Tube Hangers and Supports - Copper:

1. Description: MSS SP-58, Types 1 through 58, copper-plated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**copper-plated steel**] [**stainless steel**] <Insert material>.

2.3 THERMAL HANGER-SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psig (688 kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100 psig (688 kPa) or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psig (862 kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.
- B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.
 1. Indoor Applications: Zinc-plated steel.
 2. Outdoor Applications: Stainless steel.

2.5 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.7 MATERIALS

- A. Aluminum: **ASTM B221** (**ASTM B221M**).
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: **5000 psi** (**34.5 MPa**), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus **200 lb** (**90 kg**).

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- F. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
 - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
- G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate in accordance with ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- I. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- J. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
 3. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
 4. Install fasteners in accordance with manufacturer's written instructions.
- K. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- L. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- M. Equipment Support Installation:
1. Fabricate from welded-structural-steel shapes.
 2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
 4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils (0.05 mm)**.
2. Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36 (DN 20 to DN 900)**, requiring clamp flexibility and up to **4 inches (100 mm)** of insulation.

3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24 (DN 15 to DN 600)** if little or no insulation is required.
 4. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4 (DN 15 to DN 100)**, to allow off-center closure for hanger installation before pipe erection.
 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8 (DN 20 to DN 200)**.
 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8 (DN 10 to DN 200)**.
 10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3 (DN 10 to DN 80)**.
 11. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 13. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30 (DN 25 to DN 750)**, from two rods if longitudinal movement caused by expansion and contraction occurs.
 14. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42 (DN 50 to DN 1050)** if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 15. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24 (DN 50 to DN 600)** if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
 16. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30 (DN 50 to DN 750)** if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24 (DN 24 to DN 600)**.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24 (DN 20 to DN 600)** if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to **6 inches (150 mm)** for heavy loads.
 2. Steel Clevises (MSS Type 14): For **120 to 450 deg F (49 to 232 deg C)** piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches (32 mm)**.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F (71 deg C).
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- E. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.

- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E.

3.4 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. (1 m) of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. (1 m) of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. (8 m) along each run. Reduce intervals to 10 ft. (3 m) in areas of congested piping and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:
 - 1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 - 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
 - 3. Sanitary Waste Piping: White letters on a black background.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. TAB of domestic water system.
 - 2. Pipe-leakage test verification.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.

- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by NEBB or TABB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- D. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- E. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- F. Examine test reports specified in individual system and equipment Sections.
- G. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- H. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- I. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Domestic Water System:

- a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
- b. Water heaters are installed and functioning.
- c. Piping is complete and all points of outlet are installed.
- d. Water treatment is complete.
- e. Systems are flushed, filled, and air purged.
- f. Strainers are clean.
- g. Control valves are functioning in accordance with the sequence of operation.
- h. Shutoff and balance valves are 100 percent open.
- i. Suitable access to balancing devices and equipment is provided.

2. Sanitary Sewage/Drainage System:

- a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
- b. Piping is complete.
- c. Shutoff valves are 100 percent open.
- d. Suitable access to equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in **inch-pound (IP)** units.

3.4 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check water heater for proper discharge temperature setting.
 - 2. Check remotest point of outlet for adequate pressure.
 - 3. Check flow-control valves for proper position.
 - 4. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

3.5 PROCEDURES FOR WATER HEATERS

- A. Electric Water Heaters:
 - 1. Measure and record entering- and leaving-water temperatures.
 - 2. Measure and record water flow.
 - 3. Measure and record pressure drop.
 - 4. Measure and Record relief valve(s) pressure setting.
 - 5. Capacity: Calculate in Btu/h (kW) of heating output.
 - 6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

3.6 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
 - 1. Domestic Water Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 gpm (0.63 L/s), within 10 percent.

3.7 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in

systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.8 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Manufacturers' test data.
 2. Field test reports prepared by system and equipment installers.
 3. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
- D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
 1. Flow rates.
 2. Pipe and valve sizes and locations.
 3. Balancing stations.
 4. Position of balancing devices.

E. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Model number and unit size.
 - d. Manufacturer's serial number.
 - e. Output capacity in Btu/h (kW).
 - f. Number of stages.
 - g. Connected volts, phase, and hertz.
 - h. Rated amperage.
2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Entering-water temperature in deg F (deg C).
 - c. Leaving-water temperature in deg F (deg C).
 - d. High-temperature-limit setting in deg F (deg C).
 - e. Operating set point in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.

F. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.9 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 220593

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Sanitary waste piping exposed to freezing conditions.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material test reports.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Preformed Pipe Insulation: Type II, Class 1, unfaced.

- G. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between **minus 70 deg F (minus 57 deg C)** and **220 deg F (104 deg C)**. Comply with ASTM C534/C534M, Type I for tubular materials.
- H. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to **850 deg F (454 deg C)** in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
 - 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to **1200 deg F (650 deg C)** in accordance with ASTM C447. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ.
 - 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F (minus 73 to plus 93 deg C)**.
- C. Flexible Elastomeric Adhesive: Solvent-based adhesive.
 - 1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
 - 2. Wet Flash Point: Below **0 deg F (minus 18 deg C)**.
 - 3. Service Temperature Range: **40 to 200 deg F (4 to plus 93 deg C)**.
 - 4. Color: Black.
- D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: **Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C)**.
 - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.

4. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm (0.66 metric perms) at manufacturer's recommended dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 3. Color: White.

2.5 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
1. Permanently flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 58 to plus 176 deg F (Minus 50 to plus 80 deg C).
 3. Color: White or gray.
- C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 3. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 3 inches (75 mm).
 - 2. Thickness: 11.5 mils (0.29 mm).
 - 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches (50 mm).
 - 2. Thickness: 6 mils (0.15 mm).
 - 3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

2.9 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
 - 2. Aluminum: ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
 - 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the contract documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 2. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
 3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at **4 inches (100 mm)** o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
 - D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
 4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install prefabricated pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with **2-inch (50-mm)** overlap at seams and joints.
 2. Embed glass cloth between two **0.062-inch- (1.6-mm-)** thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with **1-1/2-inch (38-mm)** laps at longitudinal seams and **3-inch- (75-mm-)** wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with **1-inch (25-mm)** overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with **2-inch (50-mm)** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands **12 inches (300 mm)** o.c. and at end joints.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, two locations of threaded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
- B. Domestic Hot Water:
 - 1. Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
- D. Piping, Exposed:
 1. None.
 2. PVC: 30 mils (0.8 mm) thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Transition fittings - domestic water.
4. Dielectric fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product data.

1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party

certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: **ASTM B88, Type L (ASTM B88M, Type B)**.
- B. Annealed-Temper Copper Tube: **ASTM B88, Type L (ASTM B88M, Type B)**.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Wrought Copper Unions: ASME B16.22.
- H. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
 - 1. Housing: Copper.
 - 2. O-Rings and Pipe Stops: EPDM.
 - 3. Tools: Manufacturer's special tools.
 - 4. Minimum **200 psig (1370 kPa)** working-pressure rating at **250 deg F (121 deg C)**.
- I. Copper-Tube, Push-on-Joint Fittings - Domestic Water:
 - 1. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.4 PIPING JOINING MATERIALS - DOMESTIC WATER

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, **1/8 inch (3.2 mm)** thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 TRANSITION FITTINGS - DOMESTIC WATER

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.
- D. Plastic-to-Metal Transition Fittings - Domestic Water:
 - 1. Description:
 - a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket end.
- E. Plastic-to-Metal Transition Unions - Domestic Water:
 - 1. Description:
 - a. PVC four-part union.
 - b. Brass or stainless steel threaded end.
 - c. Solvent-cement-joint plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.6 DIELECTRIC FITTINGS - DOMESTIC WATER

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions - Domestic Water:
 - 1. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Flanges - Domestic Water:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated, bolted, companion-flange assembly.
 - 3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits - Domestic Water:
 - 1. Nonconducting materials for field assembly of companion flanges.
 - 2. Pressure Rating: 150 psig (1035 kPa).
 - 3. Gasket: Phenolic, Temperature Rating: 225 deg F (108 deg C).
 - 4. Bolt Sleeves: Phenolic or polyethylene.
 - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples - Domestic Water:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple complying with ASTM F1545.
 - 3. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - 4. End Connections: Male threaded or grooved.
 - 5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); copper push-on joint fittings; and push-on joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- E. Install domestic water piping level without pitch and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- F. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on joint fittings by inserting tube to measured depth.
- G. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- H. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.5 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper tube and pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within **12 inches (300 mm)** of each fitting.
- D. Support vertical runs of copper tube and pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system in accordance with either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

- A. Tests and Inspections:

1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer device.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."
2. Section 224700 "Drinking Fountains and Water Coolers."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 1. Standard: ASSE 1001.
 2. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
 3. Body: Bronze.
 4. Inlet and Outlet Connections: Threaded.
 5. Finish: Chrome plated.

2.4 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
 1. Standard: ASSE 1012.
 2. Operation: Continuous-pressure applications.
 3. Size: NPS 1/2 (DN 15).
 4. Body: Bronze.
 5. End Connections: Union, solder joint.
 6. Finish: Rough bronze.
- B. Reduced-Pressure-Principle Backflow Preventers:
 1. Standard: ASSE 1013.
 2. Operation: Continuous-pressure applications.
 3. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
 4. Body: Bronze for NPS 2 (DN 50) and smaller.
 5. End Connections: Threaded for NPS 2 (DN 50) and smaller.
 6. Configuration: Designed for vertical flow.
 7. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 WATER PRESSURE-REDUCING VALVES

- A. Water Regulators:
 1. Standard: ASSE 1003.
 2. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
 3. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller.
 4. End Connections: Threaded or solder for NPS 2 (DN 50) and smaller; flanged or solder for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.6 BALANCING VALVES

- A. Memory-Stop Balancing Valves:
 1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
 3. Size: NPS 2 (DN 50) or smaller.
 4. Body: Copper alloy.
 5. Port: Standard or full port.
 6. Ball: Chrome-plated brass or stainless steel.
 7. Seats and Seals: Replaceable.
 8. End Connections: Solder joint or threaded.
 9. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
 1. Standard: ASSE 1070.
 2. Pressure Rating: 125 psig (860 kPa).
 3. Type: Thermostatically controlled, water mixing valve.
 4. Material: Bronze body with corrosion-resistant interior components.
 5. Connections: Threaded union inlets and outlet.
 6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 7. Valve Finish: Rough bronze.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
 2. Body: Bronze for NPS 2 (DN 50) and smaller.
 3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).
 6. Drain: Pipe plug.

2.9 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: **NPS 1/2 or NPS 3/4 (DN 15 or DN 20)** threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: **125 psig (860 kPa)**.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Operation for Equipment Rooms: Wheel handle or operating key.
10. Include operating key with each operating-key hose bibb.
11. Include wall flange with each chrome- or nickel-plated hose bibb.

2.10 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: **400-psig (2760-kPa)** minimum CWP.
3. Size: **NPS 3/4 (DN 20)**.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: **125 psig (860 kPa)** minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: **NPS 1/2 (DN 15)** threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: **NPS 1/2 (DN 15)** threaded or solder joint.

6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Y-Pattern Strainers: For water, install on supply side of each control valve and water pressure-reducing valve.
- F. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- G. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- H. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Wall hydrants.
 - 7. Trap-seal primer device.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each vacuum breaker and backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections.
 - 1. Test each vacuum breaker and backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. PVC pipe and fittings.
 - 2. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

- A. Product data.

1.3 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water (30 kPa head of water).

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 PVC PIPE AND FITTINGS

- A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

- C. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F656.
- E. Solvent Cement: ASTM D2564.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 2) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 3. Do not change direction of flow more than 90 degrees.
 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: Two percent downward in direction of flow for piping **NPS 3 (DN 80)** and smaller; 1 percent downward in direction of flow for piping **NPS 4 (DN 100)** and larger.
 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install aboveground PVC piping in accordance with ASTM D2665.
- N. Install underground PVC piping in accordance with ASTM D2321.
- O. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 3. Install drains in sanitary waste gravity-flow piping.
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."
- 3.3 JOINT CONSTRUCTION
- A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- B. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings **4 inches (100 mm)** and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.4 INSTALLATION OF SPECIALTY PIPE FITTING

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Unshielded, nonpressure transition couplings.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- #### A.
1. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".

3.6 CONNECTIONS

- #### A.
- Drawings indicate general arrangement of piping, fittings, and specialties.
- #### B.
- Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- #### C.
- Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor.
 6. Comply with requirements specified in Section 221319 "Sanitary Waste Piping Specialties."
 7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections **NPS 2-1/2 (DN 65)** and larger.

- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

- a. Close openings in piping system and fill with water to point of overflow, but not less than **10 ft. head of water (30 kPa head of water)** or air test to 5 psig.
 - b. From 15 minutes before inspection starts to completion of inspection, water level or air pressure must not drop.
 - c. Inspect joints for leaks.
- 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1 inch wg (250 Pa)**.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
- 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping **NPS 4 (DN 100)** and smaller are to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, vent piping **NPS 4 (DN 100)** and smaller is to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping **NPS 4 (DN 100)** and smaller are to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Miscellaneous sanitary drainage piping specialties.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
4. Closure: Countersunk, brass plug.

5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with **NPS 1/2 (DN 15)** side inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend **2 inches (51 mm)** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to **NPS 4 (DN 100)**. Use **NPS 4 (DN 100)** for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of **50 feet (15 m)** for piping **NPS 4 (DN 100)** and smaller and **100 feet (30 m)** for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Assemble open drain fittings and install with top of hub **1 inch (25 mm)** above floor.
- F. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- 3.2 PIPING CONNECTIONS
- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 1. Standard: ASME A112.6.3.
 2. Pattern: Floor drain.
 3. Body Material: Gray iron.
 4. Outlet: Bottom.

5. Top or Strainer Material: Bronze.
6. Top of Body and Strainer Finish: Nickel bronze.
7. Top Shape: Round.
8. Top Loading Classification: Medium Duty.
9. Trap Features: Trap-seal primer valve drain connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, **30 Inches (750 mm)** or Less: Equivalent to 1 percent slope, but not less than **1/4-inch (6.35-mm)** total depression.
 - b. Radius, **30 to 60 Inches (750 to 1500 mm)**: Equivalent to 1 percent slope.
 - c. Radius, **60 Inches (1500 mm)** or Larger: Equivalent to 1 percent slope, but not greater than **1-inch (25-mm)** total depression.
 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
 1. Set grates of drains flush with finished surface, unless otherwise indicated.
 2. Install on support devices, so that top will be flush with adjacent surface.
- C. Install open drain fittings with top of hub **1 inch (25 mm)** above floor.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

- C. Install piping adjacent to equipment to allow service and maintenance.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flow-control, electric, tankless, domestic-water heaters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of commercial tankless, electric, domestic-water heater.
- B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

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

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Domestic-Water Booster Heaters:
 - 1) Controls and Other Components: Three years.
 - b. Electric, Tankless, Domestic-Water Heaters: One year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

- A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
 - 1. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
 - 2. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Flow-control fitting.
 - e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
 - 3. Support: Bracket for wall mounting.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches (457 mm) above floor on wall bracket.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to substrate.

- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Fill electric, domestic-water heaters with water.
- D. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.
- E. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial tankless, electric, domestic-water heaters. Training to be a minimum of one hour(s).

END OF SECTION 223300

SECTION 224200 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial lavatories.
2. Commercial sinks.
3. Commercial urinals.
4. Commercial water closets.
5. Flushometer valves.
6. Toilet seats.
7. Fixture carriers.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ##### A.
- Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

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

2.2 COMMERCIAL SINKS

A. Service Sinks, Floor Mounted:

1. Service Sinks, Floor Mounted - Terrazzo:
 - a. Source Limitations: Obtain sinks from single source from single manufacturer.
 - b. Fixture:
 - 1) Material: Marble chips cast in portland cement to produce a compressive strength of not less than 3000 psi (20.7 MPa), seven days after casting.
 - 2) Shape: Rectangular.
 - 3) Nominal Size: 24 by 36 inches (610 by 914 mm).
 - 4) Height: 10 inches (254 mm).
 - 5) Rim Guard: On all top surfaces.
 - 6) Drain: Grid with NPS 3 (DN 80) outlet.
 - c. Mounting: On floor and flush to wall.

2.3 COMMERCIAL LAVATORIES

A. Lavatories, Wall Mounted:

1. Lavatories, Wall Mounted - Vitreous China, Rectangular with Back:
 - a. Fixture:
 - 1) Standard: ASME A112.19.2/CSA B45.1.
 - 2) Type: For wall hanging.
 - 3) Nominal Size: Rectangular, 20 by 18 inches (508 by 457 mm).
 - 4) Faucet-Hole Punching: Three holes, 4-inch (102-mm) centers.
 - 5) Faucet-Hole Location: Top.
 - 6) Color: White.
 - 7) Mounting Material: Chair carrier.
 - b. Faucet: see "Lavatory Faucets, Manually Operated".
 - c. Support: Lavatory carrier, floor affixed with steel uprights.
 - d. Lavatory Mounting Height: Standard.

B. Lavatory Faucets, Manually Operated:

1. Standard: ASME A112.18.1/CSA B125.1.
2. Operation Type: Two handle, mixing, Commercial General duty.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.

6. Finish: Polished chrome plate.
7. Maximum Flow Rate: **0.5 gpm** (**1.9 L/min.**).
8. Mounting Type: Deck, exposed.
9. Valve Handle(s): Wrist blade, **4 inches** (**102 mm**).
10. Spout: Rigid type.
11. Spout Outlet: Aerator.
12. Drain: Not part of faucet.

C. Lavatory Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
4. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Wheel handle.
6. Risers:
 - a. **NPS 1/2** (**DN 15**).
 - b. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel, flexible hose riser.

D. Lavatory Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.
2. Drain: Grid type with **NPS 1-1/4** (**DN 32**) offset and straight tailpiece.
3. Trap:
 - a. Size: **NPS 1-1/4** (**DN 32**).
 - b. Material:
 - 1) Chrome-plated, one-piece, cast-brass trap with swivel **0.029-inch-** (**0.73-mm-**) thick tubular brass wall bend; and chrome-plated, brass or steel wall flange.

2.4 COMMERCIAL URINALS

A. Urinals, Wall Hung:

1. Urinals, Wall Hung - Back Outlet, Siphon Jet:
 - a. Fixture:
 - 1) Standards:
 - a) ASME A112.19.2/CSA B45.1.
 - b) ASME A112.19.5/CSA B45.15.

- 2) Material: Vitreous china.
 - 3) Type: Siphon jet.
 - 4) Strainer or Trapway: Manufacturer's standard strainer with integral trap.
 - 5) Water Consumption: 0.125 gpf (0.5 Lpf).
 - 6) Spud Size and Location: NPS 3/4 (DN 20); top.
 - 7) Outlet Size and Location: NPS 2 (DN 50); back.
 - 8) Color: White.
- b. Flushometer Valve: see "Flushometer Valves" Article.
 - c. Waste Fitting:
 - 1) Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - 2) Size: NPS 2 (DN 50).
 - d. Support: Urinal carrier, floor affixed with steel uprights with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
 - e. Urinal Mounting Height: Standard.

2.5 COMMERCIAL WATER CLOSETS

A. Water Closets, Floor Mounted:

- 1. Water Closets, Floor Mounted - Bottom Outlet, Close-Coupled Flushometer Tank:
 - a. Source Limitations: Obtain water closets from single source from single manufacturer.
 - b. Standard: ASME A112.19.2/CSA B45.1.
 - c. Bowl:
 - 1) Material: Vitreous china.
 - 2) Type: Siphon jet.
 - 3) Style: Flushometer tank, gravity.
 - 4) Height: Accessible in accordance with ICC A117.1.
 - 5) Rim Contour: Elongated.
 - 6) Water Consumption: 1.28 gal. (4.8 L) per flush.
 - 7) Color: White.

2.6 FLUSHOMETER VALVES

A. Flushometer Valves, Manually Operated:

- 1. Flushometer Valves, Manually Operated - Diaphragm, Lever Handle:
 - a. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
 - b. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
 - c. Minimum Pressure Rating: 125 psig (860 kPa).
 - d. Features: Include integral check stop and backflow-prevention device.
 - e. Material: Brass body with corrosion-resistant components.
 - f. Style: Exposed.

- g. Flushometer-Valve Finish: Chrome-plated.
- h. Handle Finish: Chrome plated.
- i. Consumption: 0.125 gal. (0.5 L) per flush.
- j. Minimum Inlet: NPS 3/4 (DN 20).
- k. Minimum Outlet: NPS 1-1/4 (DN 32).

2.7 TOILET SEATS

- A. Toilet Seats:
 - 1. Source Limitations: Obtain toilet seat from single source from single manufacturer.
 - 2. Standard: IAPMO/ANSI Z124.5.
 - 3. Material: Plastic.
 - 4. Type: Commercial (Heavy duty).
 - 5. Shape: Elongated rim, open front.
 - 6. Hinge: Self-sustaining, check.
 - 7. Hinge Material: Noncorroding metal.
 - 8. Seat Cover: Not required.
 - 9. Color: White.
 - 10. Surface Treatment: Antimicrobial.

2.8 FIXTURE CARRIERS

- A. Fixture Carriers - Lavatory:
 - 1. Source Limitations: Obtain lavatory carriers from single source from single manufacturer.
 - 2. Standards:
 - a. ASME A112.6.1M.
 - b. ASME A112.6.2.
- B. Fixture Carriers - Urinal:
 - 1. Source Limitations: Obtain urinal carriers from single source from single manufacturer.
 - 2. Standard: ASME A112.6.1M.
 - 3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture.
- C. Fixture Carriers - Water Closet:
 - 1. Source Limitations: Obtain water closet carriers from single source from single manufacturer.
 - 2. Standard: ASME A112.6.1M.
 - 3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture.

PART 3 - EXECUTION

3.1 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

A. Lavatory Installation:

1. Install lavatories level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted lavatories.
3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

B. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.
2. Set floor-mounted sinks in leveling bed of cement grout.
3. Install water-supply piping with stop on each supply to each sink faucet.
 - a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
 - b. Install stops/valves in locations that are accessible for ease of operation.
4. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
5. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
6. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
7. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

C. Urinal Installation:

1. Install urinals level and plumb in accordance with roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.
5. Install trap-seal liquid in waterless urinals.
6. Install supports, affixed to building substrate, for wall-hung urinals.
7. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
8. Use carriers without waste fitting for urinals with tubular waste piping.
9. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
10. Measure support height installation from finished floor, not structural floor.
11. Install flushometer-valve, water-supply fitting on each supply to each urinal.
12. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
13. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
14. Install actuators in locations easily reachable for people with disabilities.
15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
16. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

D. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
5. Use carrier supports with waste-fitting assembly and seal.
6. Install floor-mounted, back-outlet water closets, attached to building floor substrate, onto waste-fitting seals; and attach to support.
7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
8. Measure support height installation from finished floor, not structural floor.
9. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
10. Install actuators in locations easily reachable for people with disabilities.
11. Install toilet seats on water closets.
12. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

13. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 INSTALLATION OF PIPING CONNECTIONS

- A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.3 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damages finishes. Replace any fixtures unable to be repaired to the satisfaction of the Architect.
- B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Drinking fountains.
2. Water coolers.
3. Bottle filling stations.
4. Fixture carriers.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting details.
2. Details of fixture assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Diagrams for power wiring.

1.3 WARRANTY

- A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace water coolers that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Drinking fountains, water coolers, bottle filling stations, and remote water coolers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the authority having jurisdiction, and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 WATER COOLERS

A. Water Coolers - Surface Wall Mounted, Stainless Steel:

1. Source Limitations: Obtain surface wall-mounted, stainless steel, water coolers from single source from single manufacturer.
2. Standards:
 - a. NSF 61.
 - b. NSF 372.
 - c. ASME A112.19.3/CSA B45.4.
 - d. ASHRAE 18.
 - e. UL 399.
 - f. 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.
3. Type: Vandal resistant.
4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
5. Control: Push bar.
6. Bottle Filler: Sensor activation, with automatic shutoff timer: Fill rate is 0.5 to 1.5 gpm (0.03155 to 0.09464 L/s).
7. Drain: Grid with NPS 1-1/4 (DN 32) tailpiece.
8. Supply: NPS 3/8 (DN 10) with shutoff valve.
9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
10. Filter: One or more water filters with capacity sized for unit peak flow rate.
 - a. Standards:
 - 1) NSF 42.
 - 2) NSF 53.
11. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
12. Support: Fixture carrier.
13. Water-Cooler Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.
14. Capacities and Characteristics:
 - a. Cooled Water: 8 gph (0.0084 L/s).
 - b. Ambient-Air Temperature: 90 deg F (32 deg C).
 - c. Inlet-Water Temperature: 80 deg F (27 deg C).
 - d. Cooled-Water Temperature: 50 deg F (10 deg C).

2.3 BOTTLE FILLING STATIONS

A. Bottle Filling Station - Surface Wall Mounted, Stainless Steel:

1. Source Limitations: Obtain surface wall-mounted, stainless steel, bottle filling stations from single source from single manufacturer.

2. Standards:
 - a. NSF 61.
 - b. NSF 372.
 - c. ASME A112.19.3/CSA B45.4.
3. Type: Vandal resistant.
4. Cabinet: Stainless steel.
5. Bottle Filler: Sensor activation, with automatic shutoff timer. Fill rate is 0.5 to 1.5 gpm (0.03155 to 0.09464 L/s).
6. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
7. Supply: NPS 3/8 (DN 10) with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - a. Standards:
 - 1) ASHRAE 18.
 - 2) UL 399.
 - 3) 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.
10. Ventilation Grille: Stainless steel, located below bottle filler.
11. Cooling System Capacities and Characteristics:
 - a. Cooled Water: 8 gph (0.0084 L/s).
 - b. Ambient-Air Temperature: 90 deg F (32 deg C).
 - c. Inlet-Water Temperature: 80 deg F (27 deg C).
 - d. Cooled-Water Temperature: 50 deg F (10 deg C).
12. Filter: One or more water filters with capacity sized for unit peak flow rate.
 - a. Standards:
 - 1) NSF 42.
 - 2) NSF 53.
13. Support: Provide manufacturer's mounting plate.
14. Bottle Filling Station Mounting Height: Accessible in accordance with ICC A117.1.
15. Electrical Characteristics:
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - b. Volts: 120 V ac.
 - c. Phase: Single.
 - d. Hertz: 60 Hz.

2.4 FIXTURE CARRIERS

- A. Fixture Carriers:
 - 1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb in accordance with roughing-in drawings. For fixtures indicated for juveniles, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains and bottle filling stations on flat surface in accordance with manufacturer's written installation instructions.
- C. Set freestanding water coolers on floor.
- D. Install recessed drinking fountains and bottle filling stations secured to wood blocking in wall construction.
- E. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- F. Install mounting frames, affixed to building construction, and attach recessed water coolers and bottle filling stations to mounting frames.
- G. Set remote water coolers on floor unless otherwise indicated.
 - 1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- H. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- I. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

- J. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
- K. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least **1/2 inch (13 mm)** high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust electronic-sensor settings.

3.6 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

- B. Clean fixtures, on completion of installation, in accordance with manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224700

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Housed-spring isolators.
4. Spring hangers.
5. Snubbers.
6. Restraints - rigid type.
7. Restraint accessories.
8. Concrete inserts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. For each wind-load protection device that is required by this Section or is indicated on Drawings, submit the following:
 - a. Vibration Isolator Selection: Select vibration isolators and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
 - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
 - c. Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
 - d. Qualified Professional Engineer: All designated-design submittals for wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.
2. Product Listing, Preapproval, and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and basis for approval (tests or calculations).

3. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
4. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints.
- B. Welding certificates.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design system.
- B. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- C. Component Supports:
 1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Minimum deflection as indicated on Drawings.
4. Pad Material: Oil- and water-resistant rubber.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Elastomeric Isolation Mounts:

1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
2. Minimum deflection as indicated on Drawings.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psi (3447 kPa)**.
 - b. Top housing with threaded mounting holes and internal leveling device.

2.5 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Minimum deflection as indicated on Drawings.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.6 SNUBBERS

- A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC
 2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
 3. Anchors in Masonry: Design in accordance with TMS 402.
 4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 5. Resilient Cushion: Maximum 1/4-inch (6-mm) air gap, and minimum 1/4 inch (6 mm) thick.

2.7 RESTRAINTS - RIGID TYPE

- A. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.8 RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to wind-load forces.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind force loads within specified loading limits.

3.2 INSTALLATION OF VIBRATION CONTROL DEVICES

- A. Provide vibration control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- D. Equipment Restraints:
 - 1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
 - 3. Brace a change of direction longer than 12 feet (3.7 m).
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Post-Installed Concrete Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL MOTION

- A. Provide flexible connections in piping systems where they cross structural joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties" for piping flexible connections.

3.4 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 3. Test to 90 percent of rated proof load of device.
 4. Measure isolator restraint clearance.
 5. Measure isolator deflection.
 6. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

END OF SECTION 230548.13

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
 - a. Constant-volume air systems.
2. Testing, adjusting, and balancing of equipment.
3. Duct leakage tests verification.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data, including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine operating safety interlocks and controls on HVAC equipment.
- J. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Ceilings are installed.
 - g. Windows and doors are installed.
 - h. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Fans and ventilators.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.
- G. Check for airflow blockages.
- H. Check condensate drains for proper connections and functioning.
- I. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.
 - a. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-

heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure inlets and outlets airflow.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
 - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 - 2. Re-measure and confirm that total airflow is within design.
 - 3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
 - 4. Mark all final settings.
 - 5. Measure and record all operating data.
 - 6. Record final fan-performance data.

3.7 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm (47 L/s), within 10 cfm (4.7 L/s).
 - 2. Air Outlets and Inlets: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm (47 L/s), within 10 cfm (4.7 L/s).
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.8 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.9 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans performance forms, including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Fan drive settings, including settings and percentage of maximum pitch diameter.

- c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Duct, outlet, and inlet sizes.
 - 3. Position of balancing devices.
- E. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan speed.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System fan and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).

- f. Duct area in **sq. ft.** (**sq. m**).
- g. Indicated airflow rate in **cfm** (**L/s**).
- h. Indicated velocity in **fpm** (**m/s**).
- i. Actual airflow rate in **cfm** (**L/s**).
- j. Actual average velocity in **fpm** (**m/s**).
- k. Barometric pressure in **psig** (**Pa**).

G. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.10 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Valves and specialties.
3. Refrigerants.

1.2 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.

B. Shop Drawings:

1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, at a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: [**1/4 inch equals 1 ft.**]<Insert value> .

C. Delegated Design Submittals: For refrigerant piping design, including sizing and layout, oil traps, double risers, specialties, and pipe and tube sizes to accommodate, at a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Provide plans, piping schematics, and details, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Welding Certificates: For each welder performing shop or field welding on Project.
- C. Field Quality Control Reports: For each specified field quality-control test and inspection.
- D. Delegated Design Engineer Qualification Statement: For refrigerant piping design.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding, Brazing, and Fusing Qualifications."
- B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice where Project is located and who is experienced in providing engineering services of the type indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.
- B. Prepare valves and specialties for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads and other end connections.
- C. Use precautions during storage as follows:
 - 1. Maintain valve and specialty end protection.
 - 2. Store valves and specialties indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," for refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- B. Comply with ASHRAE 15 and ASHRAE 34.
- C. Comply with ASME B31.5.
- D. Test Pressure for Refrigerant R-454B:
 - 1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300 psig.

2. Suction Tubing for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Tubing: 535 psig.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube, for Refrigerant Piping: ASTM B280, Type ACR.
- B. Wrought-Copper Fittings, Brazed Joint: ASME B16.50.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8M/A5.8.
- E. Flexible Connectors:
 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 2. End Connections: Socket ends.
 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 4. Working Pressure Rating: Factory test at minimum 500 psig.
 5. Maximum Operating Temperature: 250 deg F.
- F. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:
 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. Conex Bänninger; a part of IBP Group LLC
 - b. Mueller Streamline Co.; a company of Mueller Industries
 - c. Parker Hannifin; Sporlan Division
 - d. RLS LLC
 2. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
 3. Housing: Copper.
 4. O-Rings: HNBR compatible with specific refrigerant.
 5. Tools: Manufacturer's approved special tools.
 6. Minimum Rated Pressure: 700 psig.

2.3 VALVES AND SPECIALTIES

- A. Packed-Angle Valves:
 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. Danfoss, Inc.

- b. Henry Technologies Inc.; The Henry Group
 - c. Parker (Parker Hannifin)
2. Body and Bonnet: Forged brass or cast bronze.
 3. Packing: Molded stem, back seating, and replaceable under pressure.
 4. Operator: Rising stem.
 5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 6. Seal Cap: Forged-brass or valox hex cap.
 7. End Connections: Socket, union, threaded, or flanged.
 8. Working Pressure Rating: 500 psig .
 9. Maximum Operating Temperature: 275 deg F .

B. Check Valves:

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. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries)
 - b. Danfoss, Inc.
 - c. Henry Technologies Inc.; The Henry Group
 - d. Parker (Parker Hannifin)
2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
7. End Connections: Socket, union, threaded, or flanged.
8. Maximum Opening Pressure: 0.50 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 275 deg F.

C. Service Valves:

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. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. JB Industries
 - d. Parker (Parker Hannifin)
 - e. RectorSeal HVAC; a CSW Industrials Company
 - f. Refrigeration Sales, Inc.
2. Body: Forged brass with brass cap, including key end to remove core.
3. Core: Removable ball-type check valve with stainless steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig .

7. Maximum Operating Temperature: **275 deg F**.

D. Refrigerant Locking Caps:

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. C & D Valve, LLC
 - b. JB Industries
 - c. RectorSeal HVAC; a CSW Industrials Company
 - d. Refrigeration Sales, Inc.
2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant-charging ports from unauthorized refrigerant access and leakage.
3. Material: Brass, with protective shroud or sleeve.
4. Refrigerant Identification: Color-coded, refrigerant specific based on AHRI Guideline N design.
5. Special Tool: For installing and unlocking.

E. Thermostatic Expansion Valves: Comply with **AHRI 750 I-P**.

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. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group
 - c. Parker Hannifin; Sporlan Division
2. Body, Bonnet, and Seal Cap: Forged brass or steel.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
6. Suction Temperature: **40 deg F**.
7. Superheat: Adjustable.
8. Design: Reverse-flow option (for heat-pump applications).
9. End Connections: Socket, flare, or threaded union.
10. Working Pressure Rating: **700 psig**.

2.4 REFRIGERANTS

A. R-454B, ASHRAE 34: R-32 (68.9 percent by mass) and R-1234yf (31.1 percent by mass).

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. Arkema Inc.
 - b. Honeywell International Inc.

- c. Mexichem Fluor, Inc. (Koura)
- d. The Chemours Company

2.5 Copper-Tube, Solder Fittings for Refrigerant

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one the following or of equal performance:
 - 1. Mueller Streamline Co.; a company of Mueller Industries

PART 3 - EXECUTION

3.1 PIPING APPLICATION SCHEDULES

- A. Refrigerant: R-454B.
- B. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 1-1/2 (DN 40) and Smaller, Annealed-Temper: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints .
- C. Safety-Relief-Valve Discharge Tubing for Heat-Pump Applications, Copper: Type ACR, drawn-temper or annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- E. Install flexible connectors at compressors.
- F. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to authority having jurisdiction.

3.3 INSTALLATION OF REFRIGERANT PIPING, GENERAL

- A. Requirements in this article apply to all piping materials, except where more specific requirements are specified in various pipe and fittings installation articles below.
- 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, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- C. Install refrigerant piping in accordance with ASHRAE 15.
- 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. Install piping adjacent to machines to allow service and maintenance.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to potential mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

3.4 INSTALLATION OF COPPER TUBE AND FITTINGS

- A. When brazing copper tubing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- B. Joint Construction:
 - 1. Ream ends of tubes and remove burrs.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
 - 3. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."
 - a. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.
 - 4. Copper-tube, Pressure-Seal-Joint Fittings: Construct joints in accordance with manufacturer's written instructions.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic restraints in Section 230548.13 "Vibration Controls for HVAC."
- B. Piping Attachments: Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than **20 ft.** long.
 - 2. Roller hangers and spring hangers for individual horizontal runs **20 ft.** or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping **20 ft.** or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper tube.
- C. Install hangers for metal tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within **12 inches** of each fitting.
- E. Support vertical runs of metal tubing and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

C. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System must maintain test pressure at the manifold gauge throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
4. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Procedures: Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to **500 micrometers**. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to **2 psig**.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Adjustments: Perform the following adjustments before operating the refrigeration system, in accordance with manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves but not bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow

rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Requirements:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated Design Submittals:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2.
 3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-

pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches (914 mm), select joint types in accordance with Figure 2-1.
 2. For ducts with longest side 36 inches (914 mm) or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: **G60 (Z180)** [**G90 (Z275)**].
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.
 - 2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
 - 5. Shop-Applied Coating Color: White.
 - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- D. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, **1/4-inch- (6-mm-)** minimum diameter for lengths **36 inches (900 mm)** or less; **3/8-inch- (10-mm-)** minimum diameter for lengths longer than **36 inches (900 mm)**.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: **3 inches (76 mm)**.

3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and is to be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1 (Table 5-1M)**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- D. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of **1 inch (25 mm)**, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal

flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches (38 mm)**.

- J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- K. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - 2. Fabricate 90-degree round elbows with a minimum of three segments for **12 inches (300 mm)** and smaller and a minimum of five segments for **14 inches (350 mm)** and larger.
- L. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Conditioned Space, Supply-Air Ducts in Pressure Classes **2-Inch wg (500 Pa)** and Lower: Seal Class C.
 - 3. Conditioned Space, Exhaust Ducts: Seal Class B.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1220 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."
- C. Use duct cleaning methodology as indicated in NADCA ACR.
- D. Use service openings for entry and inspection.
 - 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- E. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- F. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Supply-air ducts, dampers, actuators, and turning vanes.
4. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Provide drainage and cleanup for wash-down procedures.
6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.9 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 2- (500)inch wg (Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.

C. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1- (250)inch wg (Pa).

- b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
- c. SMACNA Leakage Class for Rectangular: 8.
- d. SMACNA Leakage Class for Round and Flat Oval: 8.

D. Intermediate Reinforcement:

- 1. Galvanized-Steel Ducts: Galvanized steel.

E. Elbow Configuration:

- 1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm (5 m/s) or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 (305) Inches (mm) and Smaller in Diameter: Stamped or pleated.

F. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Flange connectors.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Description: Gravity balanced.
- B. Performance:

1. Maximum Air Velocity: 1000 fpm (5.1 m/s).
2. Maximum System Pressure: 1 inch wg (0.25 kPa).
3. Leakage:
 - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. (15.2 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

C. Construction:

1. Frame:
 - a. Hat shaped.
 - b. 16-gauge- (1.6-mm-) thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
2. Blades:
 - a. Multiple single-piece blades.
 - b. End pivoted, maximum 6-inch (150-mm) width, 16-gauge- (1.6-mm-) thick, galvanized sheet steel with sealed edges.
3. Blade Action: Parallel.

D. Blade Seals: Neoprene, mechanically locked.

E. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 0.20 inch (5 mm).

F. Tie Bars and Brackets: Galvanized steel.

G. Return Spring: Adjustable tension.

H. Bearings: Steel ball.

I. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Chain pulls.
3. Screen Mounting:
 - a. Front mounted in sleeve.
 - 1) Sleeve Thickness: 20 gauge (1.0 mm) minimum.
 - 2) Sleeve Length: 6 inches (150 mm) minimum.
4. Screen Material: Galvanized steel.
5. Screen Type: Insect.
6. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding **40 cfm/sq. ft. (203 L/s per sq. m)** against **1-inch wg (250-Pa)** differential static pressure.
2. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
3. Frames:
 - a. Hat-shaped, **16-gauge- (1.6-mm-)** thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel; **16 gauge (1.6 mm)** thick.
5. Blade Axles: Galvanized steel.
6. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
7. Tie Bars and Brackets: Galvanized steel.
8. Locking device to hold damper blades in a fixed position without vibration.

B. Jackshaft:

1. Size: **0.5-inch (13-mm)** diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of **3/32-inch- (2.4-mm-)** thick zinc-plated steel, and a **3/4-inch (19-mm)** hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 FLANGE CONNECTORS

- A. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- B. Material: Galvanized steel.
- C. Gauge and Shape: Match connecting ductwork.

2.5 FLEXIBLE CONNECTORS

- A. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Metal-Edged Connectors: Factory fabricated with a fabric strip **3-1/2 inches (89 mm)** wide attached to two strips of **2-3/4-inch- (70-mm-)** wide, **0.028-inch- (0.7-mm-)** thick, galvanized sheet steel or **0.032-inch- (0.8-mm-)** thick aluminum sheets. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: **26 oz./sq. yd. (880 g/sq. m).**
 - 2. Tensile Strength: **480 lbf/inch (84 N/mm)** in the warp and **360 lbf/inch (63 N/mm)** in the filling.
 - 3. Service Temperature: **Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).**

2.6 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.7 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: **G90 (Z275).**

2. Exposed-Surface Finish: Mill phosphatized.

- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install flexible connectors to connect ducts to equipment.
- I. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible ducts, noninsulated.
2. Flexible duct connectors.

1.2 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."
- D. Comply with ASTM E96/E96M.

2.2 FLEXIBLE DUCTS, NONINSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Noninsulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire:
 - 1. Pressure Rating: 10 inch wg (2500 Pa) positive and 1.0 inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
- C. Flexible Ducts, Noninsulated - Class 0, Interlocking Spiral of Aluminum Foil:
 - 1. Pressure Rating: 8 inch wg (2280 Pa) positive or negative.
 - 2. Maximum Air Velocity: 5000 fpm (25 m/s).

3. Temperature Range: Minus 100 to plus 435 deg F (Minus 73 to plus 224 deg C).

2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless steel band with stainless steel or zinc-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION OF FLEXIBLE DUCTS

- A. Install flexible ducts in accordance with applicable details in the following publications:
 1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
- B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.
- C. Connect diffusers and light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- D. Connect flexible ducts to metal ducts with draw bands.
- E. Installation:
 1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
 6. Install in accordance with ADC instructions.
- F. Supporting Flexible Ducts:
 1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft. (1.2 m). Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. (42 mm per meter) between supports. A connection to rigid duct or equipment may be considered a support joint.
 2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.
 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.
 4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches (1800 mm) o.c.

END OF SECTION 233346

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grilles - fixed-blade face.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for volume-control dampers not integral to registers and grilles.

1.2 ACTION SUBMITTALS

- A. Product data.

PART 2 - PRODUCTS

2.1 GRILLES

A. Grilles - Fixed-Blade Face:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Face-Blade Arrangement: Fixed-face blade position, horizontally spaced **3/4 inch (19 mm)** apart.
4. Core Construction: Integral.
5. Frame: **1-1/4 inches (32 mm)** wide.
6. Mounting: Countersunk screw.
7. Accessory: Filter.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate registers and grilles in accordance with ASHRAE 70.

PART 3 - EXECUTION

3.1 INSTALLATION OF REGISTERS AND GRILLES

- A. Install registers and grilles level and plumb.

- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 237223.19 - PACKAGED INDOOR FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Packaged, indoor, fixed-plate, total energy-recovery units.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, elevations, and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

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

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, indoor, fixed-plate, energy-recovery units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Packaged Energy-Recovery Units: Two years.
 - 2. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- B. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE 62.1.
 - 2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. UL Compliance:
 - 1. Packaged heat-recovery ventilators shall comply with requirements in UL 1812 or UL 1815.
- E. Comply with ASTM E84 or UL 723.

2.2 PACKAGED, INDOOR, FIXED-PLATE TOTAL ENERGY-RECOVERY UNITS

- A. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1-inch (25-mm) inch- (mm-) thick thermal insulation, knockouts for electrical connections, exterior drain connection, and lifting lugs.
- C. Fixed-Plate Total Heat Exchanger:
 - 1. Casing: Galvanized steel.
 - 2. Plates: Evenly spaced and sealed and arranged for counter-flow.
 - a. Plate Material: Chemically treated paper or polymer membrane with selective hydroscopicity and moisture permeability, and gas barrier properties.
- D. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators of 1-inch (25-mm) static deflection.
 - 1. Motor and Drive: Direct driven.
 - 2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
 - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- E. Filters, particulate air filtration is specified in Section 234100 "Particulate Air Filtration."

F. Filters:

1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. UL Compliance: Comply with UL 900.
3. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
4. Filter Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.
5. Filter Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.

G. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls, so only external connections are required during installation.

1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
2. Include disconnect switches.

H. Controls:

1. Control Panel: Solid-state, programmable, microprocessor-based control unit mounted on unit.
2. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
3. Motion (Occupancy) Sensor: Passive infrared sensor for ceiling mounting with adjustable time-off delay of up to 30 minutes to energize unit.
4. Dirty filter switch.
5. Low-Voltage Transformer: Integral transformer to provide control voltage to unit from primary incoming electrical service.

2.3 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with **AHRI 1060** (**AHRI 1061**).
- C. Fan Performance Rating: Comply with AMCA 211 and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency according to AMCA 210/ASHRAE 51.
- D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260 (IP). Air-handling unit fan sound ratings shall comply with AMCA 301 or AHRI 260 (IP).
- E. UL Compliance:
 1. Packaged fixed plate energy recovery units shall comply with requirements in UL 1812; or UL 1815.
 2. Electric Coils: Comply with UL 1995.

PART 3 - EXECUTION

3.1 INSTALLATION OF PACKAGED, INDOOR, FIXED-PLATE ENERGY-RECOVERY UNITS

- A. Examine casing insulation materials and filter media before packaged, indoor, fixed-plate, energy-recovery unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- B. Install packaged, indoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.
 - 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
 - 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
 - 3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
- C. Equipment Mounting:
 - 1. Install packaged, indoor, fixed-plate, energy-recovery units on 4-inch (100-mm) cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration-isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- D. Install units with clearances for service and maintenance.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

3.2 DUCTWORK CONNECTIONS

- A. Comply with requirements for ductwork according to Section 233113 "Metal Ducts."

3.3 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished with units but not factory mounted.
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency:
 - 1. Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Packaged, indoor, fixed-plate, energy-recovery units will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy-recovery units.

END OF SECTION 237223.19

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Split-system air-conditioners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

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

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

- a. For Compressor: One year(s) from date of Substantial Completion.
- b. For Parts: One year(s) from date of Substantial Completion.
- c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SPLIT-SYSTEM AIR-CONDITIONERS

- A. Indoor Units (5 tons (18 kW) or Less:

1. Wall-Mounted, Evaporator-Fan Components:

- a. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
- b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
- c. Fan: Direct drive, centrifugal.
- d. Fan Motors:
 - 1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230500 "Common Work Results for HVAC."
 - 2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - 3) NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - 4) Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - 5) Mount unit-mounted disconnect switches on unit.
- e. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- f. Condensate Drain Pans:
 - 1) Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - a) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - b) Depth: A minimum of 1 inch (25 mm) deep.

- 2) Single-wall, galvanized-steel sheet.
- 3) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
- 4) Pan-Top Surface Coating: Asphaltic waterproofing compound.

B. Outdoor Units (5 tons (18 kW) or Less)

1. Air-Cooled, Compressor-Condenser Components:

- a. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- b. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1) Compressor Type: Scroll.
 - 2) Refrigerant: R-454B.
 - 3) Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- c. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
- d. Fan: Aluminum-propeller type, directly connected to motor.
- e. Motor: Permanently lubricated, with integral thermal-overload protection.
- f. Mounting Base: Polyethylene.

C. Accessories:

1. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
2. Automatic-reset timer to prevent rapid cycling of compressor.
3. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
4. Drain Hose: For condensate.
5. Monitoring:
 - a. Monitor constant and variable motor loads.
 - b. Monitor variable-frequency-drive operation.
 - c. Monitor economizer cycle.
 - d. Monitor cooling load.
 - e. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
 - 1. Install wall-mounted, compressor-condenser components on manufacturer's wall mounting brackets, with bottom of unit at least 24 inches above grade.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT duct raceways and elbows.
2. Fittings for conduit, tubing, and cable.
3. Joint compounds.
4. Solvent cements.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
2. Section 078413 "Penetration Firestopping" specifies firestopping referenced by this Section.
3. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. HDPE: HDPE underground conduit (thick wall).

21. HDPE-40: Schedule 40 HDPE underground conduit.
22. HDPE-80: Schedule 80 HDPE underground conduit.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERM-C-S-G.
38. RMC: See ERM-C.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

B. Definitions:

1. Conduit: A structure containing one or more duct raceways.
2. Direct Buried: Installed underground without encasement in concrete or other protective material.
3. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.
4. Duct Raceway: A single enclosed raceway for conductors or cable.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's published instructions.

1.5 QUALIFICATIONS

- A. Electrical Power Testing (EPT) Technician III: Possessing active NICET EPT Level III certification. Able to manage switching procedures; conduct tests of complex equipment; analyze test and equipment data; plan a job; and lead a team. Has experience performing NFPA 70B, IEEE, and NETA electrical tests.
- B. Electrical Power Testing (EPT) Technician IV: Possessing active NICET EPT Level IV certification. Able to conduct tests of complex metering and relay systems; evaluate tests, test equipment, test results, and power system performance; recommend actions to maintain or improve system performance; and lead multi-team projects.
- C. Electrical Power Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site electrical testing supervisors must possess active NICET EPT Technician III certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE EMT DUCT RACEWAYS AND ELBOWS

- A. UL FJMX - Stainless Steel Electrical Metal Tubing (EMT-SS) and Elbows:
 - 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. Calconduit; Atkore International.
 - b. Rymco USA brand; manufactured and listed by subsidiary Conduit S.A. de C.V.
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FJMX; including UL 797A.
 - 3. Standard Features:
 - a. Material: Stainless steel.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - c.
 - 4. Other Available Features Required by the Project:

- a. Colors: As indicated on the Drawings.

2.3 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. UL FKA V - Fittings for Type EMT Duct Raceways:

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. Arlington.
 - b. Atkore.
 - c. Bridgeport Fittings.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FKA V; including UL 514B.
3. Standard Features:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling Raintight compression coupling with distinctive color gland nut Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturer's published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Indoors:
 1. Exposed and Subject to Physical Damage: EMT.
 2. Exposed and Not Subject to Physical Damage: EMT.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Damp or Wet Locations: Corrosion-resistant EMT.
- C. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
 1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.

- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Safety: NFPA 70E.
3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
5. Communications Work: BICSI N1.
6. Life Safety and Means of Egress Work: NFPA 101.
7. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
8. Work in Confined Spaces: NFPA 350.
9. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
10. Type EMT-SS: Article 358 of NFPA 70 and NECA NEIS 101.
11. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
12. Expansion Fittings: NEMA FB 2.40.
13. Consult Architect for resolution of conflicting requirements.

- C. Special Installation Techniques:

1. Types EMT-A, ERMCA, and FMC-A: Do not install aluminum duct raceways or fittings in contact with concrete or earth.
2. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
3. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
 - a. Provide warning signs.

- D. Interfaces with Other Work:

1. Firestop penetrations of fire-rated floor and wall assemblies.
2. Provide conduit hangers and supports.

3.3 FIELD QUALITY CONTROL OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Adminstrant for Electrical Power Tests and Inspections:

1. Engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
3. Administer and perform tests and inspections

- B. Adminstrant for Communications Tests and Inspections:

1. Engage qualified communications testing and inspecting agency to administer and perform tests and inspections.
2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
3. Administer and perform tests and inspections.

C. Field tests and inspections must be witnessed by authorities having jurisdiction.

D. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
3. Conduit Placement:
 - a. Verify that center-line location and offsets are in accordance with the Drawings.
 - b. Verify that hangers and supports for conduits are attached to structure as directed by qualified structural engineer.
 - c. Verify that nuts on bolts or hanger rods are secure.
 - d. Verify that space between raceways and cored holes are filled with non-shrinking grout or other approved material indicated on the Drawings and the Specifications.
 - e. Verify that expansion devices are installed at locations indicated on the Drawings and the Specifications.
 - f. Verify that ends are cut square to provide flush-butting surfaces when spliced and inside edges are free of burrs that could impede installation of cables.
 - g. Verify minimum separation of utilities, or that approved mechanical protection has been provided to surrounding conduit(s) where minimum separation cannot be achieved.
4. Document all changes on Record Drawings.

E. Nonconforming Work:

1. Conduit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

F. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 CLEANING

- A. Verify that bentonite or other drilling fluids are contained and removed, and site is restored to its original or improved condition.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" specifies materials and methods for sealing penetrations of rated walls and partitions referenced by this Section.
2. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 DEFINITIONS

A. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

1. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
2. Concrete Box: A box intended for use in poured concrete.
3. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
4. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
5. Cover Plate: A cover designed for protecting wiring devices installed in flush-mounted device boxes while permitting their safe operation; also called a faceplate or wallplate.
6. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
7. Device Box: A box with provisions for mounting a wiring device directly to the box.
8. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
9. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
10. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.

11. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 12. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 13. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 14. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 15. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 16. Raised-Floor Box: A floor box intended for use in raised floors.
 17. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 18. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 19. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 20. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 21. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
- B. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
- C. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of product requiring samples for source quality control.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's published instructions.

1.5 QUALIFICATIONS

- A. Electrical Power Testing (EPT) Technician III: Possessing active NICET EPT Level III certification. Able to manage switching procedures; conduct tests of complex equipment;

analyze test and equipment data; plan a job; and lead a team. Has experience performing NFPA 70B, IEEE, and NETA electrical tests.

- B. Electrical Power Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site electrical testing supervisors must possess active NICET EPT Technician III certification.
- C. Security Testing and Inspecting Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site security testing supervisor must have ASIS PSP certification and documented training and experience with testing security equipment in accordance with ASIS testing standards.
- D. Fire-Alarm Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site fire-alarm testing supervisor must possess active NICET I&TFAS Technician II certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. Source Quality Control:
- B. UL QCIT - Metallic Outlet Boxes and Covers:
 - 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. ABB Electrification Installations Products.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Arlington Industries, Inc.
 - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
3. Standard Features:
 - a. Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel.
 - c. Sheet Metal Depth: Minimum 1.5 inch.
 - d. Cast-Metal Depth: Minimum 1.8 inch.
4. Other Available Features Required by the Project:
 - a. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
 - b. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

C. UL QCIT - Metallic Conduit Bodies:

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. ABB Electrification Installations Products.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Pass & Seymour; Legrand North America, LLC.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
3. Standard Features: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

D. UL QCIT - Metallic Device Boxes:

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. ABB Electrification Installations Products.
 - b. Appleton; Emerson Electric Co., Automation Solutions.

- c. Arlington Industries, Inc.
 - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
- a. UL CCN QCIT; including UL 514A.
3. Standard Features:
- a. Box with provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel.
 - c. Sheet Metal Depth: minimum 1.5 inch.
 - d. Cast-Metal Depth: minimum 1.8 inch.

E. UL QCIT - Metallic Extension Rings:

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. ABB Electrification Installations Products.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
- a. UL CCN QCIT; including UL 514A.
3. Standard Features: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

2.3 JUNCTION BOXES AND PULL BOXES

A. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

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. ABB.
 - b. Appleton.
 - c. Hubbell.

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN BGUZ; including UL 50 and UL 50E.
3. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 - b. Degree of Protection: Type 2 Type 12 Type 12K.

2.4 COVER PLATES FOR DEVICE BOXES

A. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

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. ABB.
 - b. Appleton.
 - c. Hubbell.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Standard Features:
 - a. Cover plate-Securing Screws: Metal with head color to match cover plate finish.
 - b. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - c. Cover Plate Material: 0.032 inch thick, Type 302/304 non-magnetic stainless steel with brushed finish Galvanized steel.

B. UL QCIT or QCMZ - Nonmetallic Cover Plates for Device Boxes:

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. Eaton.
 - b. Legrand.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

- a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
- 3. Standard Features:
 - a. Cover Plate-Securing Screws: Metal with head color to match cover plate finish.
 - b. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - c. Cover Plate Material: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
 - d. Color: White.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Indoors:
 - a. Damp or Dusty Locations: Type 12 Type 2 Type 4 Type 5.
 - b. Locations Exposed to Hosedown: Type 4 Type 6 Type 6P.
 - c. Locations Exposed to Corrosive Agents: Type 4X Type 6P.
 - d. Locations Exposed to Spraying Oil or Coolants: Type 13.
- C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
 - 1. Boxes with knockouts or unprotected openings are prohibited.
 - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Safety: NFPA 70E.
 - 3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
 - 4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 - 5. Communications Work: BICSI N1.
 - 6. Life Safety and Means of Egress Work: NFPA 101.
 - 7. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
 - 8. Work in Confined Spaces: NFPA 350.

9. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
10. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
11. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - b. Provide gaskets for cover plates and covers.

D. Interfaces with Other Work:

1. Identification: Provide labels for boxes and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Label each enclosure with engraved metal or laminated-plastic nameplate.
 - c. Provide warning signs and arc-flash hazard warning labels for electrical equipment.

3.3 FIELD QUALITY CONTROL OF BOXES AND COVERS

A. Administrator for Electrical Power Tests and Inspections:

1. Engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 3. Administer and perform tests and inspections.
- B. Administrant for Communications Tests and Inspections:
1. Engage qualified communications testing and inspecting agency to administer and perform tests and inspections.
 2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 3. Administer and perform tests and inspections.
- C. Administrant for Security Tests and Inspections:
1. Engage qualified security testing and inspecting agency to administer and perform tests and inspections.
 2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 3. Administer and perform tests and inspections.
- D. Administrant for Fire-Alarm Tests and Inspections:
1. Engage qualified fire-alarm testing and inspecting agency to administer and perform tests and inspections.
 2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 3. Administer and perform tests and inspections.
- E. Field tests and inspections must be witnessed by authorities having jurisdiction.
- F. Tests and Inspections:
1. Perform manufacturer's recommended tests and inspections.
 2. Perform tests and inspections recommended by standards listed in "Reference Standards for Installation" Paragraph.
- G. Nonconforming Work:
1. Boxes and covers will be considered defective if they do not pass tests and inspections.
 2. Remove and replace defective units and retest.
- H. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.
- 3.4 CLEANING
- A. Remove construction dust and debris from boxes before installing cover plates, covers, and hoods.

3.5 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Tags.
3. Signs.
4. Cable ties.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 LABELS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN PGDQ2 for components; including UL 969.

- B. UL PGDQ2 - Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

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. Brady Corporation.
 - b. Champion America.
 - c. Grafoplast Wire Markers.

- d. LEM Products Inc.
- C. UL PGDQ2 - Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
- 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. A'n D Cable Products.
 - b. Brady Corporation.
 - c. Brother International Corporation.
 - d. Grafoplast Wire Markers.
 - 2. Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating, with protective shield over legend. Size labels such that clear shield overlaps entire printed legend.
 - 3. Marker for Labels:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. UL PGDQ2 - Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
- 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. A'n D Cable Products.
 - b. Brady Corporation.
 - c. Brother International Corporation.
 - d. Grafoplast Wire Markers.
 - 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inch for raceway and conductors.
 - b. 3-1/2 by 5 inch for equipment.
 - c. As required by authorities having jurisdiction.

2.2 EXTRUDED INSULATING TUBING

- A. Performance Criteria:
- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN YDPU2 for components; including UL 224.

- B. UL YDPU2 - Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F.
 - 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. Brady Corporation.
 - b. Panduit Corp.

2.3 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
 - 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. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Seton Identification Products; a Brady Corporation company.
 - d. emedco.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
 - 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. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Grafoplast Wire Markers.
 - d. LEM Products Inc.
 - e. emedco.
- C. Write-on Tags:
 - 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. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. LEM Products Inc.
 - d. Pipemarket.com; Brimar Industries, Inc.
 - e. Seton Identification Products; a Brady Corporation company.

2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 SIGNS

A. Baked-Enamel Signs:

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. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Champion America.
 - d. Marking Services Inc.
 - e. emedco.
2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inch.

B. Laminated Acrylic or Melamine Plastic Signs:

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. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services Inc.
 - d. Seton Identification Products; a Brady Corporation company.
 - e. emedco.
2. Engraved legend.
3. Thickness:
 - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. inch, 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. HellermannTyton.
 - 2. Ideal Industries, Inc.
 - 3. Marking Services Inc.
 - 4. Panduit Corp.
- B. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN ZODZ; including UL 1565 or UL 62275.
- C. UL ZODZ - General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- D. UL ZODZ - UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- E. UL ZODZ - Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

- A. Comply with 29 CFR 1910.144 for color identification of hazards, and the following:
 - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- B. Pipe and Conduit Labeling: Comply with ASME A13.1 and IEEE C2.
- C. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - 1. Color must be factory applied or field applied for sizes larger than 6 AWG when permitted by authorities having jurisdiction.
 - 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480Y/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral (Grounded Conductor): White or gray.
 - 6. Color for Equipment Ground: Bare copper Green Green with yellow stripe.
 - 7. Color for Isolated Ground: Green with two or more yellow stripes.
- D. Color-Coding Raceways, Cable Trays, Junction Boxes, and Conductors for Intrinsically-Safe Circuits: Light blue. When used to identify intrinsically-safe circuits, Article 504 of NFPA 70 requires that the color light blue not be used for any other purpose.
- E. Color-Coding Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- F. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
 - 4. .

- G. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- H. Locations of Underground Lines: Underground-line warning tape for power and lighting.
- I. Vaults, Manholes, Handholes, and Pull and Junction Boxes, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels snap-around labels snap-around color-coding bands self-adhesive vinyl tape to identify phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
 - 2. Identify system voltage and system or service type with black letters on orange field.
- J. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
 - 2. Identify system voltage and system or service type with black letters on orange field.
- K. Conductors to Be Extended in Future: Attach write-on tags to conductors.
- L. Cover Plates: Label individual cover plates with self-adhesive labels. Place label at top of cover plate. Label cover plate with the following information, in the order listed:
 - 1. Panelboard designation.
 - 2. Colon or dash.
 - 3. Branch circuit number.
- M. Equipment Identification Labels:
 - 1. Black letters on white field.
 - 2. Indoor Equipment: Baked-enamel signs Laminated acrylic or melamine plastic sign.
 - 3. Outdoor Equipment: Laminated acrylic or melamine sign Stenciled legend 4 inch high.
 - 4. Equipment to Be Labeled:
 - a. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
 - b. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
 - c. Enclosures and electrical cabinets.
 - d. Access doors and panels for concealed electrical items.
 - e. Emergency system boxes and enclosures.
 - f. Motor-control centers.
 - g. Enclosed switches.
 - h. Enclosed circuit breakers.
 - i. Enclosed controllers.
 - j. Variable-speed controllers.
 - k. Push-button stations.
 - l. Power-transfer equipment.

- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Battery-inverter units.
- p. Battery racks.
- q. Monitoring and control equipment.

N. Cable Ties: General purpose, for attaching tags, except as listed below:

- 1. Outdoors: UV-stabilized nylon.
- 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 SELECTION OF SIGNS AND HAZARD MARKINGS

A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.

B. Signs, labels, and tags required for personnel safety must comply with the following standards:

- 1. Safety Colors: NEMA Z535.1.
- 2. Facility Safety Signs: NEMA Z535.2.
- 3. Safety Symbols: NEMA Z535.3.
- 4. Product Safety Signs and Labels: NEMA Z535.4.
- 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Electrical Hazard Warnings:

- 1. Arc-Flash Hazard Warning: Self-adhesive labels. Comply with NFPA 70E requirements for arc-flash hazard warning labels.
- 2. Multiple Power Sources Warning Legend: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
- 3. OSHA Workspace Clearance Warning Legend: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels Baked-enamel warning signs.

- 1. Apply to exterior of door, cover, or other access.
- 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
 - c. .

E. Operating Instruction Signs: Self-adhesive labels Baked-enamel warning signs Laminated acrylic or melamine plastic signs.

3.4 INSTALLATION

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes typical for electrical equipment environments specified in Section 260011 "Facility Performance Requirements for Electrical."
- C. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- D. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.
- E. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- F. Install identifying devices before installing acoustical ceilings and similar concealment.
- G. Verify identity of item before installing identification products.
- H. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- I. Apply identification devices to surfaces that require finish after completing finish work.
- J. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- M. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- O. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

- P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- Q. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- R. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- T. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- U. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape not less than 12 inch directly above cables or raceways buried 18 inch or more below grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
 - 2. Limit use of underground-line warning tape to direct-buried cables.
 - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- V. Metal Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using UV-stabilized cable ties.
- W. Nonmetallic Preprinted Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using UV-stabilized cable ties.
- X. Write-on Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using UV-stabilized cable ties.
- Y. Baked-Enamel Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- Z. Metal-Backed Butyrate Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- AA. Laminated Acrylic or Melamine Plastic Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

END OF SECTION 260553

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panelboards.
2. Disconnecting and overcurrent protective devices.

B. Related Requirements:

1. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. In addition to information identified in Section 013300 "Submittal Procedures," submit the following:

1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
2. Include manufacturer's sample extended warranty language.

B. Shop Drawings: For each panelboard and related equipment:

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.

11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards.
- B. Manufacturer's published instructions.
- C. Field Reports:
 1. Manufacturer's field reports for field quality-control support.
 2. Field reports for voltage monitoring and adjusting.
 3. Field reports for infrared scanning.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare parts.
- B. Special tools.

1.7 QUALIFICATIONS

- A. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation in accordance with NECA 407 NEMA PB 1.

1.9 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
 - 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
 - 1. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.
 - 2. Follow-On Extended-Warranty Period: Five years from date of Substantial Completion; prorated coverage for materials that failed because of transient voltage surges only, free on board origin, freight prepaid.

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS TO BE MODIFIED

- A. Basis for Pricing: Square D 208/120V 3P 4W, 200A Bus 200A MCB 40 Pole Panel.
- B. Accessories: Square D Circuit Breakers 10KIAC.

2.2 EXISTING PRODUCTS TO BE REMOVED AND REINSTALLED

- A. Basis for Pricing: Square D Circuit Breakers 10KIAC.

2.3 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic forces specified in Section 018123 "Facility Seismic and Wind Criteria."
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Comply with NEMA PB 1.
- E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: UL 50E, [Type 1].
 - b. Kitchen and Wash-Down Areas: UL 50E, Type 4X, stainless steel.
 - c. Other Wet or Damp Indoor Locations: UL 50E, Type 4.
 - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 5 Type 12.
2. Height: 7 ft maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
 - a. Panels and Trim: [Steel], factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

F. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating must run entire length of bus.
 - b. Bus must be fully rated for entire length.
2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations must allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with lug on neutral bar for each pole in panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with lug on bar for each pole in panelboard.

- H. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- I. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - 1. Percentage of Future Space Capacity: 5 percent.
- J. Panelboard Short-Circuit Current Rating:
 - 1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.
 - a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
 - b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.
 - 2. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
 - a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
 - b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2.4 PANELBOARDS

- A. UL QEUY - Lighting and Appliance Branch-Circuit Panelboard:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Square D; Schneider Electric USA.
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Lighting and Appliance Branch-Circuit Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.

4. Standard Features:
 - a. Mains: Circuit breaker.
 - 1) Location: Convertible between top and bottom.
 - 2) Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
 - b. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
5. Other Available Features Required by Project:
 - a. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.
 - b. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 - c. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
 - d. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors must be sized for double-sized or parallel conductors as indicated on Drawings.
 - e. Do not mount neutral bus in gutter.
 - f. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
 - g. Doors: Door-in-door construction with concealed hinges; secured with flush or multipoint latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Square D; Schneider Electric USA.

2.6 MAINTENANCE MATERIAL ITEMS

- A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
 1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and GFPE Types: Two spares for each panelboard.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
- B. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
 2. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NECA 407 NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 407 NEMA PB 1.1.
 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 1. Equipment Mounting:
 - a. Install floor-mounted panelboards on cast-in-place concrete equipment base(s).
 - b. Attach panelboard to vertical finished or structural surface behind panelboard.

- c. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
 - d. Provide seismic control devices.
- 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- 3. Provide mounting and anchoring devices.
- 4. Mount top of trim 7.5 ft above finished floor unless otherwise indicated.
- 5. Mount panelboard cabinet plumb and rigid without distortion of box.
- 6. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- 7. Install overcurrent protective devices and controllers not already factory installed.
 - a. Set field-adjustable, circuit-breaker trip ranges.
 - b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
- 8. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- 9. Install filler plates in unused spaces.
- 10. Stub four 1 inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch empty conduits into raised floor space or below slab not on grade.
- 11. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- 12. Mount spare fuse cabinet in accessible location.
- D. Interfaces with Other Work:
 - 1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components.
- B. Install warning signs.
- C. Panelboard Nameplates: Label each panelboard with nameplate.
- D. Device Nameplates: Label each branch circuit device in power panelboards with nameplate.
- E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

- F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
- G. Circuit Directory:
 - 1. Provide directory card inside panelboard door, mounted in transparent card holder.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
 - 2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
 - 3. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

- A. Administrant for Low-Voltage Electrical Tests and Inspections:
 - 1. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
 - 2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 - 3. Administer and perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Field tests and inspections must be witnessed by authorities having jurisdiction.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

- b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
- c. Instruments and Equipment:
 - 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Nonconforming Work:
 - 1. Panelboards will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- F. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.
 - 1. Include certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- G. Manufacturer Services: Engage factory-authorized service representative to supervise field tests and inspections.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 - 1. Measure loads during period of normal facility operations.
 - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 - 4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luminaires.
2. Luminaire fittings.

B. Related Requirements:

1. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 DEFINITIONS

- A. BUG Rating: Backlight, uplight, and glare rating for light pollution from exterior luminaires.
- B. Correlated Color Temperature (CCT): The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.
- C. Color Rendering Index (CRI): The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.
- D. IDA: International Dark-Sky Association.
- E. IES: Illuminating Engineering Society.
- F. LPD: Lighting power density.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Luminaires: Include the following additional information:

- a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.

- 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
 - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
- b. Product Certificates: Include product certificates stating compliance with standards listed below, signed by manufacturer or fabricator.
- 1) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with current accreditation under National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
 - 2) Testing Agency Certified Data: For luminaires indicated on Lighting Fixture Schedule on the Drawings, photometric data certified by qualified independent testing laboratory. Photometric data for remaining luminaires must be certified by manufacturer.
- c. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- d. Include operating characteristics, electrical characteristics, and furnished accessories.
- e. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.
- f. Include battery and charger data for emergency lighting units.
- g. Include ballast factor.
- h. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
- i. Include photometric data and adjustment factors obtained from qualified laboratory tests.
- j. Include manufacturer's sample warranty language.
- k. Luminaire Fittings: Include the following additional information:
- l. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
- 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
 - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
- m. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- n. Include operating characteristics, electrical characteristics, and furnished accessories.
- o. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.
- p. Include manufacturer's sample warranty language.

B. Shop Drawings: Prepare and submit the following:

1. Drawings, Diagrams, and Supporting Documents for Custom Luminaires:

- a. Include plans, elevations, sections, and mounting and attachment details.
- b. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- c. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' published instructions.

B. Field Reports:

- 1. Manufacturer's field reports for field quality-control support.
- 2. Manufacturer's field reports for system startup support.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare parts.

B. Extra stock material.

1.7 MOCKUPS

A. Provide mockups as indicated on the Drawings to verify selections made under Sample submittals and to set quality standards for materials and execution.

- 1. Build mockup of luminaires in room or space, complete with power and control connections.
- 2. Obtain Architect's approval of mockups before starting installation of related Work on the Project.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Maintain mockups during construction in undisturbed condition as standard for judging the completed Work.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 QUALIFICATIONS

- A. Electrical Power Testing (EPT) Technician III: Possessing active NICET EPT Level III certification. Able to manage switching procedures; conduct tests of complex equipment; analyze test and equipment data; plan a job; and lead a team. Has experience performing NFPA 70B, IEEE, and NETA electrical tests.
- B. Electrical Power Testing (EPT) Technician IV: Possessing active NICET EPT Level IV certification. Able to conduct tests of complex metering and relay systems; evaluate tests, test equipment, test results, and power system performance; recommend actions to maintain or improve system performance; and lead multi-team projects.
- C. Electrical Power Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 1. On-site electrical testing supervisors must possess active NICET EPT Technician III certification.
- D. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under NIST HB 150-1, and complying with applicable IES testing standards.
- E. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with applicable IES standards.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.

1.10 WARRANTY FOR LUMINAIRES

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed luminaires perform in accordance with specified requirements and agrees to repair or replace products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.
 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

- B. Special Manufacturer Extended Warranty: Manufacturer warrants that luminaires perform in accordance with specified requirements and agrees to provide repair or replacement of products that fail to perform as specified within extended-warranty period.
 - 1. Extended-Warranty Period: Five years from date of Substantial Completion; full coverage for labor, materials, and equipment.

1.11 WARRANTY FOR BATTERIES

- A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended-warranty period.
 - 1. Initial Extended-Warranty Period for Li-ion Batteries: Three years from date of Substantial Completion; full coverage for materials only, free on board destination, freight prepaid.
 - 2. Follow-On Extended-Warranty Period for Li-ion Batteries: 10 years from date of Substantial Completion; prorated coverage for materials only, free on board destination, freight prepaid.
 - 3. Initial Extended-Warranty Period for Ni-Cd Batteries: Five years from date of Substantial Completion; full coverage for materials only, free on board destination, freight prepaid.
 - 4. Follow-On Extended-Warranty Period for Ni-Cd Batteries: 15 years from date of Substantial Completion; prorated coverage for materials only, free on board destination, freight prepaid.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 LUMINAIRES

- A. UL FWBO - Exit Fixture:
 - 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. Amerlux.
 - b. Cooper Lighting Solutions; Signify North America Corp.
 - c. Evenlite, Inc.
 - d. Hubbell Lighting; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. Listing Criteria:

- a. Exit Fixtures: UL CCN FWBO; including UL 924, NFPA 101, and ICC IBC.
 - b. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
3. Standard Features:
- a. Nominal Operating Voltage: 120 V(ac) 277 V(ac).
 - b. Light Source: LED; 50,000 hours minimum rated life.
 - c. Legend Color: Red.
 - d. Internal emergency power unit.
 - e. Battery Type: Ni-Cd.
 - f. Master/Remote Sign Configurations:
 - 1) Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in battery for power connection to remote unit.
 - 2) Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.
4. Installation Markings:
- a. All Luminaires (UL CCN HYXT):
 - 1) "SUITABLE FOR DAMP LOCATIONS."
 - 2) "SUITABLE FOR WET LOCATIONS."
 - 3) "SUITABLE FOR MOUNTING WITHIN 1.2 M (4 FT) OF THE GROUND" or "SUITABLE FOR FLOOR PROXIMITY INSTALLATION."
 - 4) Marked to identify voltage supply or type of branch circuit or both.

2.3 LUMINAIRE FITTINGS

A. Luminaire Support Accessories:

1. Standard Features:
- a. Sized and rated for luminaire weight.
 - b. Capable of maintaining luminaire position after cleaning and relamping.
 - c. Capable of supporting luminaire without causing deflection of ceiling or wall.
 - d. Capable of supporting horizontal force equal to 100 percent of luminaire weight and vertical force equal to 400 percent of luminaire weight.

2.4 MAINTENANCE MATERIAL ITEMS

- A. Spare Parts: Furnish to Owner spare parts, for repairing lighting equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents.

- B. Extra Stock Material: Furnish to Owner extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Include the following:
 - 1. Incandescent Lamps: 1 of each type and rating installed. Furnish at least one of each type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Lighting: If approved by Architect, specified luminaires for the Project may be installed for temporary lighting. Install and energize minimum quantity of luminaires necessary to meet needs of construction activities. When construction is sufficiently complete, remove, disassemble, clean, and relamp luminaires used for temporary lighting before reinstalling for the Project's delivery.

3.3 INSTALLATION OF LIGHTING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 - 3. Work in Confined Spaces: NFPA 350.
 - 4. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 - 5. Installation of Indoor Lighting Systems: NECA NEIS 500.
 - 6. Installation of Exterior Lighting Systems: NECA NEIS 501.
 - 7. Installation of Industrial Lighting Systems: NECA NEIS 502.
 - 8. Installation of Luminaires, Lampholders, and Lamps: Article 410 of NFPA 70.
 - 9. Installation of Extra-Low-Voltage Lighting: Article 411 of NFPA 70.
 - 10. Installation of Lighting for Sensitive Electronic Equipment: Article 647 of NFPA 70.
 - 11. Installation of Emergency Lighting and Exit Signs: ICC IBC, NFPA 101, and Parts IV and V in Article 700 of NFPA 70.
 - 12. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
2. Install luminaires at height and aiming angle as indicated on the Drawings.
3. Coordinate layout and installation of luminaires with other construction.
4. Adjust luminaires that require field adjustment or aiming.
5. Exterior Bollard Luminaires:
 - a. Align units for optimum directional alignment of light distribution.
6. Flush-Mounted Luminaire Support:
 - a. Secured to outlet box.
 - b. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - c. Trim ring flush with finished surface.
7. Wall-Mounted Luminaire Support: Attached to a minimum 1/8 inch backing plate attached to wall structural members.
 - a. Do not attach luminaires directly to gypsum board.
8. Suspended Luminaire Support:
 - a. Ceiling Mount:
 - 1) Hook hangers.
 - 2) Two wires.
 - 3) Two aircraft cables.
 - b. Pendants and Rods: Where longer than 48 inch, brace to limit swinging.
 - c. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - d. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and tubing or rod wire support for suspension for each unit length of luminaire chassis, including one at each end.
 - e. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
9. Install wiring connections for luminaires.
10. Identification: Provide labels for luminaires and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Provide warning signs.
 - c. Label each enclosure with engraved metal or laminated-plastic nameplate.

D. Interfaces with Other Work:

1. Coordinate with Architectural.

- E. Systems Integration: Integrate lighting control devices and equipment with electrical power connections for operation of luminaires as specified.

3.4 FIELD QUALITY CONTROL OF LIGHTING

- A. Administrant for Electrical Power Tests and Inspections:
 1. Engage qualified electrical testing and inspecting agency to administer and perform tests and inspections.
 2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 3. Administer and perform tests and inspections.
- B. Administrant for Field Tests and Inspections of Lighting Installations:
 1. Engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.
 2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 3. Administer and perform tests and inspections.
- C. Field tests and inspections must be witnessed by authorities having jurisdiction.
- D. Tests and Inspections:
 1. Perform manufacturer's recommended tests and inspections.
 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 3. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
 4. Verify operation of photoelectric controls.
 5. Exterior Illumination Tests:
 - a. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.
- E. Nonconforming Work:
 1. Luminaire will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.
- F. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.
- G. Manufacturer Services: Engage factory-authorized service representative to supervise field tests and inspections.

1. Manufacturer's Field Reports for Field Quality-Control Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at the Project's site.

3.5 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's published instructions.
2. Burn-in lamps that require specific aging period to operate properly, prior to occupancy by Owner.
3. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
4. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.
5. .

B. Manufacturer Services: Engage factory-authorized service representative to supervise system startup.

1. Manufacturer's Field Reports for System Startup Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at the Project's site.

3.6 ADJUSTING

A. Luminaire Aiming Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aiming direction of luminaires to suit occupied conditions. Make up to two visits to the Project's site during other-than-normal hours for this purpose. Some of the Work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
3. Adjust aim of luminaires in presence of Architect.

3.7 CLOSEOUT ACTIVITIES

A. Training:

1. Train Owner's maintenance personnel on the following topics:
 - a. How to adjust, operate, and maintain luminaires.
- 2.

3.8 PROTECTION

- A. After installation, protect lighting equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 265000

SECTION 281400 - ACCESS CONTROL SYSTEM HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access control system units.
2. Access control system power supplies and battery chargers.

B. Related Requirements:

1. Section 281500 "Integrated Access Control Hardware Devices" for access control field devices controlled by hardware specified in this Section.

1.2 DEFINITIONS

- A. DGP: Data gathering panel.
- B. LAN: Local area network.
- C. RAID: Redundant array of inexpensive disks; redundant array of independent disks.
- D. RAM: Random-access memory.
- E. WAN: Wide area network.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Coordination Meeting(s): For access control system hardware. Conduct meeting(s) as videoconference or at Project site before installation.
1. Attendees: Installers, fabricators, representatives of manufacturers, representatives from telecommunications, Owner's security representatives, IT representatives, and administrators for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Access control system units.
2. Access control system power supplies and battery chargers.

B. Shop Drawings:

1. Project general notes.
2. Hardware and equipment locations.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. Hardware and equipment installation details.
6. Secondary power calculations.

C. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation instructions for access control system servers.
2. Installation instructions for access control system DGPs.
3. Installation instructions for access control system input/output interface.
4. Installation instructions for access control system door controllers.
5. Installation instructions for access control system workstation.
6. Manufacturer's recommended testing and inspection procedure for operation of access control system servers, panels, input/output interfaces, door controllers, and workstations.
7. Installation instructions for access control system power supplies and battery chargers.
8. Manufacturer's recommended testing and inspection procedure for operation of access control system power supplies and battery chargers.
9. Installation instructions for access control system printers.
10. Manufacturer's recommended testing and inspection procedure for operation of access control system printers.

B. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.7 WARRANTY FOR ACCESS CONTROL SYSTEM HARDWARE

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed access control system hardware perform in accordance with specified requirements and agrees to repair or replace systems, assemblies, components, or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

B. Special Manufacturer Extended Warranty: Manufacturer warrants that access control system hardware perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.
2. Follow-On Extended-Warranty Period: Eight years from date of Substantial Completion; full coverage for materials only, free on board destination, freight prepaid.

1.8 WARRANTY FOR BATTERIES

- A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended-warranty period.

1. Initial Extended-Warranty Period for Li-ion Batteries: Three years from date of Substantial Completion; full coverage for materials only, free on board destination, freight prepaid.
2. Follow-On Extended-Warranty Period for Li-ion Batteries: Ten years from date of Substantial Completion; prorated coverage for materials only, free on board destination, freight prepaid.
3. Extended-Warranty Period for Ni-MH Batteries: Three years from date of Substantial Completion; prorated coverage for materials only, free on board destination, freight prepaid.
4. Extended-Warranty Period for Ni-Cd Batteries: Five years from date of Substantial Completion; prorated coverage for materials only, free on board destination, freight prepaid.
5. Warranted Cycle Life for Valve Regulated (Sealed) Lead Acid Batteries: Equal to or greater than that represented in manufacturer's published table, but not less than the following, based on annual average battery temperature of 77 deg F:
 - a. For discharge rate not faster than eight hours, discharge duration not longer than eight hours, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than six discharge cycles.
 - b. For discharge rate not faster than 30 minutes, discharge duration not longer than 30 minutes, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 20 discharge cycles.
 - c. For discharge rate not faster than 15 minutes, discharge duration not longer than 45 seconds, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 120 discharge cycles.
6. Warranted Cycle Life for Premium Valve Regulated (Sealed) Lead Acid Batteries: Equal to or greater than that represented in manufacturer's published table, but not less than the following, based on annual average battery temperature of 77 deg F:
 - a. For discharge rate not faster than eight hours, discharge duration not longer than eight hours, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 40 discharge cycles.
 - b. For discharge rate not faster than 30 minutes, discharge duration not longer than 30 minutes, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 125 discharge cycles.
 - c. For discharge rate not faster than 15 minutes, discharge duration not longer than 90 seconds, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 750 discharge cycles.

7. Warranted Cycle Life for Flooded (Wet Cell or Open) Lead Acid Batteries: Equal to or greater than that represented in manufacturer's published table, but not less than the following, based on annual average battery temperature of 77 deg F and preventive maintenance performed in accordance with manufacturer's published instructions:
 - a. For discharge rate not faster than eight hours, discharge duration not longer than eight hours, and voltage at end of discharge not less than 1.75 V, warranted life must be not fewer than 40 discharge cycles.
 - b. For discharge rate not faster than one hour, discharge duration not longer than one hour, and voltage at end of discharge not less than 1.75 V, warranted life must be not fewer than 80 discharge cycles.
 - c. For discharge rate not faster than 15 minutes, discharge duration not longer than 45 seconds, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 2700 discharge cycles.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL SYSTEM UNITS

- A. Description: This category covers head end units for access control systems, providing a means of regulating or controlling physical entry into an area, or access to or use of device by electrical, electronic, and/or mechanical means. Access control systems are investigated as complete configuration based upon manufacturer's specified system components. Access control systems are intended to comply with applicable life safety access and egress requirements.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.
 2. Listing Criteria: UL CCN ALVY; including UL 294.
- C. Access Control System DGPs:
- D. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Lenel
 2. Source Limitations: Obtain products from single manufacturer.
 3. Additional Characteristics:
 - a. Data ports for connection to LAN and downstream DGPs.
 - b. Integral terminal blocks secured to enclosure.
 - c. Enclosure lock with tamper switch and monitoring.
 - d. .

4. Options:
 - a. Input Voltage: 120 V(ac).
 - b. Internal Power Supply: 24 V(dc) power supply.
 - c. Operating Temperature: 32 to 120 deg F.
 - d. Materials: Steel.
 - e. Battery Backup: 24 V.
 - f. Mounting: Wall mount Cabinet mount.

E. Access Control System Door Controllers:

1. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Lenel.
2. Source Limitations: Obtain products from single manufacturer.
3. Additional Characteristics:
 - a. Data ports for connection to LAN and downstream controllers.
 - b. Integral terminal blocks for connection of inputs/outputs to field devices.
 - c. Controller Inputs:
 - 1) Auxiliary input.
 - 2) Door contact.
 - 3) Request to exit.
 - 4) Cabinet tamper.
 - 5) Power monitor.
 - d. Controller Outputs:
 - 1) Auxiliary output.
 - 2) Door strike.
 - 3) Door operators.
 - 4) Credential readers.
4. Options:
 - a. Input Voltage: 24 V(dc).
 - b. Operating Temperature: 32 to 158 deg F.
 - c.
 - d. Mounting: Cabinet mount.

F. Access Control System Input/Output Interface:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. LenelS2; Carrier Global Corporation.
 - b. **<Insert manufacturer's name>**.

2. Source Limitations: Obtain products from single manufacturer.
3. Additional Characteristics:
 - a. Input Voltage: 12 to 24 V(dc).
 - b. Operating Temperature: 32 to 158 deg F.
 - c. Data ports for connection to LAN and downstream panels/controllers.
 - d. Integral terminal blocks for connection of inputs/outputs to field devices.
 - e. Inputs:
 - 1) Auxiliary inputs from building systems.
 - 2) Door contact.
 - 3) Cabinet tamper.
 - 4) Power monitor.
 - f. Outputs:
 - 1) Auxiliary outputs to building systems.
 - 2) Door strike.
 - 3) Credential readers.

2.2 ACCESS CONTROL SYSTEM POWER SUPPLIES AND BATTERY CHARGERS

- A. Description: This category covers power supplies and battery chargers for access control system units, controllers, input/output interfaces, workstations, printers, and encoders.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.
 2. Listing Criteria: UL CCN ALVY; including UL 294.
- C. Access Control System Power Supply and Battery Charger:
 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. Altronix Corp.
 2. Source Limitations: Obtain products from single manufacturer.
 3. Additional Characteristics:
 - a. Input Voltage: 120 V(ac).
 - b. Output Voltage: 24 V(dc).
 - c. Operating Temperature: 32 to 120 deg F.

- d. Network connection for remote supervision, management, and testing.
 - e. Enclosure lock with tamper switch and monitoring.
 - f. Built-in battery charger.
4. Options:
- a. Mounting: Cabinet mount.
5. Accessories:
- a. DIN rails for mounting.

2.3 ELECTRICALLY CONTROLLED SINGLE-POINT LOCKS AND LATCHES

- A. Description: This category covers single-point electrified locksets, including cylindrical and mortise-style locks, which are connected to the access control system via hardwired cabling or wireless. Electrified locksets communicate with credential readers through the access control system to unlock doors upon credential authorization. Electrified locksets may also be programmed to lock or unlock directly via a signal from the access control system without the need for credential authorization.
- B. Performance Criteria:
- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Special Locking Arrangements: UL CCN FWAX; including UL 294, NFPA 101, and ICC IBC.
 - b. Electrically Controlled Single-Point Locks and Latches: UL CCN GYQS, UL 10B, and UL 10C; designed to be used with Class 2 control-voltage circuits in accordance with Article 725 of NFPA 70.
- C. Electrically Controlled Single-Point Latch:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - b. Design Hardware; Mesker Openings Group; dormakaba.
 - c. Schlage; an Allegion brand.
 - d. Security Door Controls.
 - e. Yale Security Inc; ASSA ABLOY.
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Options:
 - a. Audible and visual indication of door unlock.
 - b. Input Power: 24 V(ac/dc).
 - c. Operating Temperature: Minus 31 to plus 151 deg F (Minus 35 to plus 66 deg C).

- d. Connectivity: Hardwired.
- e. Integrated Credential Reader:
 - 1) Proximity (125 kHz).
 - 2) Smart (13.56 MHz).
 - 3) Bluetooth low energy (2.4 GHz).
 - 4) NFC.
- f. Failure Mode: Fail-secure.
- g. Mechanical key override.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESS CONTROL SYSTEM HARDWARE

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Installation of Access Control System Hardware and Wiring: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with requirements in guide information for UL CCN ALVY.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Interfaces with Other Work:
 - 1. Coordinate installation of new products for access control system hardware with existing conditions.
 - 2. Coordinate with Fire Alarm System for interfacing security system inputs/outputs with fire-alarm system inputs/outputs.

3.2 FIELD QUALITY CONTROL OF ACCESS CONTROL SYSTEM HARDWARE

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 - 1. Perform manufacturer's recommended tests and inspections.
- C. Nonconforming Work:
 - 1. Hardware and components will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Collect, assemble, and submit test and inspection reports.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to supervise field tests and inspections.

3.3 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's published instructions.
2. .

3.4 ADJUSTING

A. Adjust printers and ribbons to function smoothly, and lubricate as recommended in writing by manufacturer.

3.5 PROTECTION

A. After installation, protect access control system hardware from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 281400

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a new fire alarm control unit (FACU) with new addressable initiating, notification, and monitoring devices. The new fire alarm control units will be connected to the existing fire alarm system in the office/maintenance garage. The 8 bay south and 8 bay north garages will both be placed on the open zone idc#2 and 10 bay garages will be placed on the open zone idc#8. All systems will be supervised by a cellular communicator.

- B. Applicable Codes and Standards:

MUBEC (2025): Maine Uniform Building and Energy Code

International Code Council Codes:

IBC (2021): International Building Code

IEBC (2021): International Existing Building Code

National Fire Protection Association Standards:

NFPA 1 (2018): Fire Code

NFPA 4 (2024): Standard for Integrated Fire Protection and Life Safety System Testing

NFPA 13 (2016): Standard for The Installation of Sprinkler Systems

NFPA 22 (2013): Standard for Water Tanks for Private Fire Protection

NFPA 24 (2013): Standard for The Installation of Private Fire Service Mains and Their Appurtenances

NFPA 25 (2014): Standards for The Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

NFPA 70 (2023): National Electrical Code

NFPA 72 (2019): National Fire Alarm and Signaling Code

NFPA 101 (2018): Life Safety Code

NFPA 170 (2024): Standard for Fire Safety and Emergency Symbols

NFPA 241 (2019): Standard for Safeguarding Construction, Alteration, And Demolition Operations

NFPA 291 (2025): Recommended Practice for Water Flow Testing and Marking of Hydrants

- C. Section Includes:

1. Existing fire-alarm system to be modified.
2. Addressable fire-alarm system.
3. Fire-alarm control unit (FACU).
4. Fire-alarm notification appliances.

- D. Related Requirements:

1. Section 211313 "Wet Pipe Sprinkler Systems"
2. Section 211316 "Dry Pipe Sprinkler Systems"

1.2 DEFINITIONS

- A. SAP: Sprinkler Alarm Panel
- B. DACT: Digital alarm communicator transmitter.
- C. EMT: Electrical metallic tubing.
- D. FATC: Fire Alarm Terminal Cabinet
- E. FACU: Fire-alarm control unit.
- F. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- G. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- H. NICET: National Institute for Certification in Engineering Technologies.
- I. PC: Personal computer.
- J. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.3 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, and details, including details of attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Panel details as required by authorities having jurisdiction.
5. Detail assembly and support requirements.
6. Include voltage drop calculations for notification-appliance circuits.
7. Include battery-size calculations.
8. Include input/output matrix.
9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Qualification Statements: For Designer and Installer Qualifications must be provided prior to shop drawing submittal.
- C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Record copy of site-specific software.
 - g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

- 1) Equipment tested.
- 2) Frequency of testing of installed components.
- 3) Frequency of inspection of installed components.
- 4) Requirements and recommendations related to results of maintenance.
- 5) Manufacturer's user training manuals.

- h. Manufacturer's required maintenance related to system warranty requirements.
- i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On **approved online or cloud solution**.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to **10** percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to **10** percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to **10** percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to **two** percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
6. Audible and Visual Notification Appliances: **One** of each type installed.
7. Fuses: **Two** of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.7 QUALITY ASSURANCE

A. Designer Qualification:

1. A minimum NICET Level III fire alarm technician or a licensed fire protection engineer, (either on staff or who they work in conjunction with) is required to develop calculations, shop drawings, and provide cut sheets for products to be installed, for approval by the owner's representative.

B. Installer Qualifications:

1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. Installation must be by personnel certified by NICET as fire-alarm **Level II** technician.
3. Obtain certification by NRTL in accordance with NFPA 72.

4. Licensed or certified by authorities having jurisdiction.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXISTING FIRE-ALARM SYSTEM TO BE MODIFIED

- A. Description: Existing Simplex 4005 Fire Alarm Control Panel.
- B. Source Limitations for Fire-Alarm System and Components: Components must be compatible with, and operate as extension of, existing system. Provide system manufacturer's certification that components provided have been tested as, and will operate as, a system.

2.2 ADDRESSABLE FIRE-ALARM SYSTEM

- A. Description:
 1. Noncoded, **UL-certified FM Global-placarded** addressable system, with multiplexed signal transmission and **horn-and-strobe** notification for evacuation.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.
 2. General Characteristics:
 - a. Fire-alarm signal must initiate the following actions:
 - 1) Continuously operate alarm notification appliances.
 - 2) Identify alarm and specific initiating device at FACU.
 - 3) Transmit alarm signal to remote alarm receiving station.
 - 4) Activate emergency lighting control.
 - 5) Activate emergency shutoffs for gas and fuel supplies.
 - 6) Record events in system memory.
 - 7) Record events by system printer.

- b. Supervisory signal initiation must be by one or more of the following devices and actions:
 - 1) Valve supervisory switch.
 - 2) High- or low-air-pressure switch of dry-pipe or preaction sprinkler system.
 - 3) Independent fire-detection and -suppression systems.
 - 4) Power to fire pump has phase reversal.
 - 5) Zones or individual devices have been disabled.
 - 6) FACU has lost communication with network.

- c. System trouble signal initiation must be by one or more of the following devices and actions:
 - 1) Open circuits, shorts, and grounds in designated circuits.
 - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4) Loss of primary power at FACU.
 - 5) Ground or single break in internal circuits of FACU.
 - 6) Abnormal ac voltage at FACU.
 - 7) Break in standby battery circuitry.
 - 8) Failure of battery charging.
 - 9) Abnormal position of switch at FACU or annunciator.

- d. System Supervisory Signal Actions:
 - 1) Initiate notification appliances.
 - 2) Identify specific device initiating event at FACU.
 - 3) Record event on system printer.
 - 4) After time delay of **200 seconds**, transmit trouble or supervisory signal to remote alarm receiving station.

- e. Network Communications:
 - 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
 - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.
 - 3) Provide integration gateway using **Modbus** for connection to building automation system.

- f. Document Storage Box:
 - 1) Description: Enclosure to accommodate standard **8-1/2-by-11 inch (216-by-279 mm)** manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
 - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
 - 3) Color: Red powder-coat epoxy finish.

- 4) Labeling: Permanently screened with 1 inch (25 mm) high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
- 5) Security: Locked with 3/4 inch (19 mm) barrel lock. Provide solid 12 inch (304 mm) stainless steel piano hinge.

2.3 FIRE-ALARM CONTROL UNIT (FACU)

- A. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- B. Performance Criteria:
 1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
 2. General Characteristics:
 - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
 - b. Include real-time clock for time annotation of events on event recorder and printer.
 - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
 - d. FACU must be listed for connection to central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
 - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
 - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
 - g. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1) Pathway Survivability: **Level 0**.
 - 2) Install no more than **256** addressable devices on each signaling-line circuit.
 - 3) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
 - h. Serial Interfaces:
 - 1) One dedicated RS 485 port for **central-station** operation using point ID DACT.
 - 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - 3) One **USB** port for PC configuration.
 - 4) One RS 232 port for air-aspirating smoke detector connection.
 - 5) One RS 232 port for voice evacuation interface.

i. Notification-Appliance Circuit:

- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
- 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
- 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.

j. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.

- 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.

k. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, must be powered by 24 V(dc) source.

l. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.

m. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

n. Batteries: **Sealed, valve-regulated, recombinant lead acid.**

2.4 FIRE ALARM TERMINAL CABINET (FATC)

A. **Construction:**

1. Provide a minimum 16-gauge steel enclosure with a hinged door and a high-quality red baked-enamel finish.
2. The cabinet shall be sized to accommodate all required terminal strips with a minimum of **20% spare capacity** for future expansion.
3. The door shall be clearly labeled "**FIRE ALARM TERMINAL CABINET**" in white 1-inch block lettering.
4. Provide a keyed cylinder lock, keyed to the project standard (typically CAT 45 or CAT 60).

B. **Internal Components:**

1. **Terminal Strips:** Provide heavy-duty, screw-terminal barrier strips rated for 600V.
2. **Identification:** All terminal points shall be permanently labeled with alphanumeric identifiers matching the record drawings.
3. **Wire Management:** Include integrated wire-way duct (e.g., Panduit) or hook-and-loop fasteners to ensure a neat and organized internal layout.

2.5 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

1. Description: Horns, bells, or other notification devices that cannot output voice messages.
2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.

b. General Characteristics:

- 1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
- 2) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
- 3) Chimes, Low-Level Output: Vibrating type, 75 dB(A-weighted) minimum rated output.
- 4) Chimes, High-Level Output: Vibrating type, 81 dB(A-weighted) minimum rated output.
- 5) Sounders, High Volume 24 V(dc): **Less than 6 mA** of alarm current.
- 6) Sounders, Low Volume 24 V(dc): **Less than 4 mA** of alarm current.
- 7) Audible notification appliances must have functional humidity range of **10 to 95** percent relative humidity.
- 8) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured **10 ft. (3 m)** from horn, using coded signal prescribed in UL 464 test protocol.
- 9) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1971.

b. General Characteristics:

- 1) Rated Light Output:
 - a) 15, 30, 75, 110 cd, selectable in field.
- 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
- 5) Flashing must be in temporal pattern, synchronized with other units.
- 6) Strobe Leads: Factory connected to screw terminals.
- 7) Mounting Faceplate: Factory finished, **white**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:
 - 1. Notify **Owner** no fewer than **seven** days in advance of proposed interruption of fire-alarm service.
 - 2. Do not proceed with interruption of fire-alarm service without **Owner's** written permission.
- C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before other trades have completed cleanup must be replaced.
 - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing Simplex 4005 Fire Alarm Control Panel in existing part of building.
 2. Connect new equipment to existing monitoring equipment at supervising station.
 3. Expand, modify, and supplement existing **monitoring** equipment as necessary to extend existing functions to new points. New components must be capable of merging with existing configuration without degrading performance of either system.
- C. Install wall-mounted equipment, with tops of cabinets not more than **78 inch (1980 mm)** above finished floor.
1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- D. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- E. Audible Alarm-Indicating Devices: Install not less than **6 inch (150 mm)** below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inch (150 mm)** below ceiling. Install devices at same height unless otherwise indicated.
- G. Fire Alarm Terminal Cabinet:
1. Placement:
 - a. Install terminal cabinets in accessible locations, typically at the transition point between the garage bays and the main building or adjacent to the Fire Alarm Control Panel (FACP).
 - b. Mount the cabinet such that the top is no more than **72 inches (1830 mm)** above the finished floor.
 2. Wiring Standards:
 - a. All fire alarm circuits entering or leaving the terminal cabinet shall be neatly trained and bundled.
 - b. No more than two (2) conductors shall be installed under a single terminal screw.
 - c. **Splices are strictly prohibited.** All wire transitions must occur on the terminal strips.
- 3.4 ELECTRICAL CONNECTIONS
- A. Connect wiring in accordance with Division 26 Specification.
- B. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least **1/2 inch (13 mm)** high.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Division 26 Specification.
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.
 1. Exposed pathways located less than **96 inch (2440 mm)** above floor must be installed in EMT.
- B. Pathways must be installed in EMT.
- C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

- A. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than **36 inch (910 mm)** from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
 1. Supervisory connections at valve supervisory switches.
 2. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in location visible from FACU.

3.9 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by **authorities having jurisdiction**.
- B. Administrant for Tests and Inspections:
 1. Owner will engage qualified testing agency to administer and perform tests and inspections.

2. Engage qualified testing agency to administer and perform tests and inspections.
3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
4. Administer and perform tests and inspections.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
4. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
5. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.10 DEMONSTRATION

A. **Train** Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. **Allow Owner to record training.**

3.11 MAINTENANCE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.12 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for **two** years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least **30** days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11

APPENDIX A

HAZARDOUS MATERIALS REPORT



CREDERE ASSOCIATES, LLC

776 Main Street
Westbrook, Maine 04092
Phone: 207-828-1272
Fax: 207-887-1051

December 29, 2025

Mike Kelley
Colby Co Engineering
47A York Street
Portland, ME 04101
Submitted via email: mikek@colbyengineering.com

**Subject: Pre-Renovation Hazardous Building Materials Survey Report
Maine Turnpike Authority
150 Fletcher Street, Kennebunk ME**

Dear Mike:

The attached report has been prepared to present the results of the pre-renovation Hazardous Building Materials Survey (HBMS) completed for the above-referenced property (Site), and **Section 4** of the report includes our conclusions and recommendations.

Please do not hesitate to contact me at (207) 828-1272 or akeith@credereassoc.com if you have any questions, comments, or require additional information regarding this investigation.

Sincerely,
CREDERE ASSOCIATES, LLC

Alison Keith
Environmental Specialist



CREDERE ASSOCIATES, LLC

776 Main Street
Westbrook, Maine 04092
Phone: 207-828-1272
Fax: 207-887-1051

Hazardous Building Materials Survey Report

**Maine Turnpike Authority
150 Fletcher Street
Kennebunk Maine 04043**

Prepared for:

**Colby Co Engineering
47A York Street
Portland, Maine 04101**

Prepared by:

**Credere Associates, LLC
776 Main Street
Westbrook, Maine 04092**

December 29, 2025



In Reference to:

Credere Project No. 25002060

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APPENDICES

Appendix A	Inspector Certification Documents
Appendix B	Photograph Log
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1. INTRODUCTION

Creder Associates, LLC (Creder) was retained by Colby Co Engineering (the Client) to conduct a Pre-Renovation Hazardous Building Materials Survey (HBMS) of the Maine Turnpike Authority buildings located at 150 Fletcher St in Kennebunk, York County, Maine (Site). The HBMS was performed to assess materials likely to be impacted during planned upgrades to the fire suppression systems in 5 buildings. This survey was completed in conformance with Creder's proposal dated November 21, 2025.

1.1 PURPOSE AND STATEMENT OF OBJECTIVES

This section was developed to provide clarity and transparency in communicating and interpreting survey results. The primary purpose of this survey is to identify hazardous building materials that may be impacted by future renovations and document their location and quantity.

The following objectives were established to aid in designing the scope of work (SOW):

- Complete an asbestos-containing materials (ACM) survey to identify ACM that may be impacted by future renovations.
- Complete a lead-containing paint (LCP) survey of painted or coated surfaces to define if and where LCP is located in areas to be impacted by renovations.
- Conduct polychlorinated biphenyls (PCB) containing materials sampling and testing to identify PCB-containing materials that will require special disposal under Maine's solid waste rules.

1.2 SITE DESCRIPTION

The Site is developed with multiple buildings at 150 Fletcher Street. The Site is currently used as the Maine turnpike authority garages and office building for the Kennebunk shed. Fire suppression system upgrades are planned for 5 buildings where various materials will be impacted. General descriptions of the buildings are provided below:

- Two (2) eight bay (8) garage buildings each 7,000 square feet, constructed in 1970
- One ten (10) bay garage building approximately 11,000 square feet constructed in 2003
- Office and maintenance buildings that are each approximately 18,00 square feet and constructed in approximately 2003



2. SCOPE OF WORK & METHODOLOGY

The following sampling program was implemented to meet the objectives identified in **Section 1**.

2.1 ACM SAMPLING

On November 20, 2025, a Credere Maine-Certified Asbestos Inspector surveyed the Site buildings for the presence of suspect ACM in areas to be impacted by the fire suppression system upgrades. Copies of the inspector's certifications are included in **Appendix A**. The sampling was performed in accordance with Maine Department of Environmental Protection (DEP) Chapter 425: Asbestos Management Regulations (Chapter 425).

Twelve (12) materials were sampled in triplicate for a total of 36 individual ACM samples. Photographs of sampled materials are included in **Appendix B**, and Site building plans showing sample locations are included as **Figures 2** through **Figure 5**. A summary of the suspected ACM samples collected is included as **Table 1**.

Samples were shipped to EMSL Analytical, Inc. (EMSL) of South Portland, Maine, and analyzed using Polarized Light Microscopy (PLM) according to the U.S. Environmental Protection Agency (EPA) Method 600/R-93/116 with the non-organically bound (NOB) preparation procedure utilized when required. The laboratory was advised to employ the positive stop procedure such that additional replicates are not analyzed if an initial sample is positive for asbestos.

2.2 LEAD PAINT SURVEY

On November 20, 2025, painted surfaces throughout the Site buildings were screened for lead in paint using an X-ray fluorescence (XRF) meter. A total of 54 independent points were screened within/on the Site buildings in areas to be impacted by renovations. Screening locations were based on unique testing combinations of building component, substrate, and paint color. In general, areas tested included ceilings, walls, windows, doors, and exterior sidings in each building. A summary of the lead paint screening locations is included as **Table 2**.

2.3 PCB-CONTAINING BUILDING MATERIALS

On November 20, 2025, Credere surveyed the Site building to identify suspect PCB-containing building materials and determine if the building materials are regulated as PCB bulk product waste as defined by 40 CFR 761.3.

No building materials were identified as suspect PCB-containing materials in areas of the buildings to be impacted by renovations. No samples for PCB's were collected at the time of the assessment.

3. RESULTS

The following subsections present the results of the data collected during this HBMS.

3.1 ACM RESULTS

Laboratory analytical results for asbestos bulk samples were compared to the 1% limit specified in the Maine DEP Chapter 425. Materials with concentrations of asbestos greater than 1% are considered ACM and are required to be abated per Maine DEP Chapter 425 prior to demolition of these materials. Using the “positive stop” method, 143 of 147 of the samples were analyzed by the laboratory. A summary of collected asbestos sample results and approximate quantity estimates are provided in **Table 1**, and the complete laboratory analytical report is provided in **Appendix C**.

All samples collected were negative for asbestos.

3.2 LEAD PAINT SURVEY RESULTS

Lead-based paint (LBP) is defined as paint with a lead concentration of 1.0 milligrams per square centimeter (mg/cm²) in accordance with applicable state regulations. Lead-containing paint (LCP) is defined as paint with any detectable level of lead. During any demolition that impacts LBP and/or LCP, proper measures should be taken by employers to protect worker health according to the US Occupational Safety and Health Administration (OSHA) Lead in Construction Standards (29 CFR 1926.62). Paints with any detectable concentration of lead may also be regulated for proper disposal when out of use, and any demolition waste containing these paints should be properly characterized prior to disposal and disposed at an appropriate facility according to applicable Maine disposal regulations.

A list of each lead XRF screening location and the corresponding concentration of lead is provided in **Table 2**. Results indicated lead containing paint (LCP) was detected in the following areas: 8 bay garage buildings both North and South on the ceilings and exterior siding. In the 10-Bay garage building on the walls, metal door jam, and tan painted pipe. In the office building mechanical room on the sprinkler riser pipe, the windows to be impacted in the 10-bay garage, the walls and ceiling in the tool storage room, and on the steel columns in the 4-bay storage area. No lead-based paint (LBP) was detected.



4. CONCLUSIONS & RECOMMENDATIONS

Credere has performed a Pre-renovations Hazardous Building Materials Survey at the Maine Turnpike Authority buildings located at 150 Fletcher Street in Kennebunk, Maine. The primary purpose of this survey was to identify hazardous building materials that may be impacted by the future planned renovation of the Site building and document their location and quantity. The survey has met the following objectives listed in **Section 1.1**. If the renovation plans change or extend to other areas, additional inspection and sampling may be required.

4.1 CONCLUSIONS

Credere's conclusions considering the results of this HBMS include the following:

- No ACM were identified in areas to be impacted by renovations.
- LCP were identified throughout the Site buildings interior and exterior.
- No suspect PCB materials were identified in areas to be impacted by renovations.

4.2 RECOMMENDATIONS

Based on the findings and conclusions of this survey, Credere makes the following recommendations:

- Contractors performing future demolition involving painted surfaces should employ proper health and safety practices and do proper worker notifications to prevent exposure to lead in paint. Proper measures should be taken by employers to protect worker health according to the US Occupational Safety and Health Administration (OSHA) lead in construction standards in 29 CFR 1926.62.



5. LIMITATIONS

This report has been prepared as part of a contract agreement between Credere and the Client. This agreement was established in order to provide the Client with information upon which they can rely concerning the existence or likely existence of hazardous building materials at the Site. This report does not reflect:

- Areas not part of the original scope of work
- Conditions in inaccessible and/or otherwise untested areas
- Variations in contaminant concentrations that can occur between sample locations
- Variations in conditions that occurred at a time other than when the Site inspection was completed

In the event that any conditions different from those described herein are encountered at a later time, Credere Associates, LLC requests an opportunity to review such differences and modify the assessment and conclusions of this report. This report was prepared expressly for the purpose described. The information in this report may not be suitable for any other use without adaptation for the specific purpose intended. Any such reuse of this report, without adaptation, shall be at the sole risk and liability of the party undertaking the reuse.

This project was completed in accordance with relevant, applicable, and appropriate standards and was performed by exercising the degree of care and skill ordinarily exercised by a duly qualified or certified inspector. However, there is a possibility that hidden, inaccessible, or otherwise unassessed ACM, PCB-containing materials, paint, or universal waste may exist at the Site. If suspect materials are identified during any future Site operations including maintenance, renovations, housekeeping, or general demolition, the party performing these activities should first refer to this report. If conclusive results cannot be obtained, additional sampling and analysis must be conducted by a duly qualified or certified inspector prior to the initiation of any activities that may impact or in any way disturb potential unassessed materials.

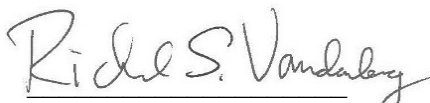


6. SIGNATURES

The following individuals are licensed professionals certified to perform the above listed work in the respective jurisdiction and possess sufficient specific education, training, and experience necessary to exercise professional judgment to develop opinions and conclusions regarding the existence of hazardous building materials at the Site. Copies of applicable certificates/licenses are included in **Appendix A**.



Alison Keith
Environmental Specialist
Maine Certified Asbestos Inspector
Maine Certified Lead Inspector



Richard Vandenberg, PG, LG
Senior Project Manager
Final Review

TABLES

Table 1
Asbestos Sample Summary and Results
Maine Turnpike Authority
150 Fletcher Street
Kennebunk, Maine

Sample Number	Sample Location	Material	Asbestos Content	Approximate Quantity of ACM
CA-SACM-01 (A-C)	8 Bay North Floor	Concrete, Gray	ND	NA
CA-SACM-02 (A-C)	8 Bay South Floor	Concrete, Gray	ND	NA
CA-SACM-03 (A-C)	10 Bay Garage Floor	Caulk, Gray	ND	NA
CA-SACM-04 (A-C)	Office Building-Mechanical room	Sheetrock, Light Gray	ND	NA
CA-SACM-05 (A-C)	Office Building-Mechanical room	Cove Base Mastic, Yellow	ND	NA
CA-SACM-06 (A-C)	Maintenance Building-Tool Storage	CMU Mortar, Gray	ND	NA
CA-SACM-07 (A-C)	Maintenance Building-Tool Storage	Sheetrock, Light Gray	ND	NA
CA-SACM-08 (A-C)	Maintenance Building-Tool Storage	Joint Compound, White	ND	NA
CA-SACM-09 (A-C)	10 Bay Garage	Expainsion Joint Caulk, Gray	ND	NA
CA-SACM-10 (A-C)	10 Bay Garage	CMU Mortar, Gray	ND	NA
CA-SACM-11 (A-C)	10 Bay Garage Floor	Concrete, Gray	ND	NA
CA-SACM-12 (A-C)	Maintenance Building Floor 4 Bay Building Floor Office Mechanical Room Floor	Concrete, Gray	ND	NA

SACM - suspect asbestos-containing material
NA - Not applicable
LF - linear feet

Total # of Samples: 36
Total Analyzed: 36

Table 2
Lead-Containing Paint Survey Summary and Results
Maine Turnpike Authority
150 Fletcher Street, Kennebunk, Maine

Company	Viken Detection
Model	Pb200i
Instrument Type	XRF Lead Paint Analyzer
Serial Number	2069
App Version	Pb200i-4.1-11

Reading #	Concentration	Units	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Color
1	1	mg/cm2	Calibration							
2	0.9	mg/cm2								
3	0.9	mg/cm2								
4	0	mg/cm2								
5	0	mg/cm2								
6	0	mg/cm2								
8 Bay Garage - North										
7	0.1	mg/cm2	Garage	Garage	Ceiling	Wood			Intact	White
8	0	mg/cm2	Garage	Garage	Wall	Wood	B		Intact	White
9	0	mg/cm2	Garage	Window	Sill	Wood	B		Intact	White
10	0	mg/cm2	Garage	Window	Frame	Wood	B		Intact	White
11	0	mg/cm2	Garage	Garage	Wall	Wood	B		Intact	White
12	0	mg/cm2	Garage	Garage	Wall	Wood	C		Intact	White
13	0	mg/cm2	Garage	Column	N/A	Wood			Intact	Orange
14	0	mg/cm2	Garage	Column	N/A	Wood			Intact	White
15	0	mg/cm2	Garage	Garage	Wall	Wood	D		Intact	White
16	0	mg/cm2	Garage	Garage	Wall	Wood	D		Intact	White
17	0	mg/cm2	Garage	Window	Sill	Wood	D		Intact	White
18	0	mg/cm2	Garage	Window	Frame	Wood	D		Intact	White
19	0	mg/cm2	Garage	Window	Frame	Wood	A		Intact	White
20	0	mg/cm2	Garage	Door	Frame	Wood	B		Intact	White
21	0	mg/cm2	Garage	Door	Jamb	Wood	B		Deteriorated	White
8 Bay Garage - South										
22	0	mg/cm2	Garage	Garage	Wall	Wood	A		Deteriorated	White
23	0	mg/cm2	Garage	Garage	Wall	Wood	B		Intact	White
24	0	mg/cm2	Garage	Garage	Wall	Wood	B		Intact	White
25	0	mg/cm2	Garage	Garage	Wall	Wood	C		Intact	White
26	0.1	mg/cm2	Garage	Garage	Ceiling	Wood			Intact	White
27	0	mg/cm2	Garage	Garage	Wall	Wood	D		Intact	White
28	0	mg/cm2	Garage	Garage	Wall	Wood	D		Intact	White
29	0	mg/cm2	Garage	Window	Frame	Wood	C		Intact	White
30	0	mg/cm2	Garage	Window	Sill	Wood	D		Intact	White
31	0	mg/cm2	Garage	Column		Wood			Intact	Orange
10 Bay Garage										
32	0	mg/cm2	Garage	Garage	Wall	Concrete	D		Intact	White
33	0.1	mg/cm2	Garage	Garage	Wall	Concrete	A		Intact	White
34	0.1	mg/cm2	Garage	Garage	Wall	Concrete	B		Intact	White
35	0.3	mg/cm2	Garage	Door	Jamb	Metal	B		Intact	Tan
36	0	mg/cm2	Garage	Door		Metal	B		Intact	Tan
37	0.1	mg/cm2	Garage	Garage	Wall	Concrete	C		Intact	White
38	0.2	mg/cm2	Garage	Pipe		Metal	C		Intact	Tan
39	0	mg/cm2	Garage	Garage	Ceiling	Wood			Intact	White
Office and Maintenance Buildings										
40	0	mg/cm2	Mech. Room	Room	Wall	Drywall	B		Intact	Gray
41	0	mg/cm2	Mech. Room	Room	Ceiling	Drywall	B		Intact	White
42	0.1	mg/cm2	Mech. Room	Pipe		Metal	B		Intact	Red
43	0.1	mg/cm2	Mech. Room	Pipe		Metal	B		Intact	Black
44	0	mg/cm2	Kitchen	Window	Frame	Metal	C		Intact	Silver
45	0.2	mg/cm2	Garage	Window		Concrete	A		Intact	Blue
46	0.1	mg/cm2	Garage	Room	Wall	Concrete	C		Intact	Gray
47	0.1	mg/cm2	Garage-Tool Stor.	Room	Wall	Drywall	A		Intact	Gray
48	0.2	mg/cm2	Garage-Tool Stor.	Room	Ceiling	Drywall			Intact	White
49	0	mg/cm2	Garage-4 Bay	Room	Wall	Metal	A		Intact	Gray
50	0	mg/cm2	Garage-4 Bay	Room	Wall	Metal	B		Intact	Gray
51	0	mg/cm2	Garage-4 Bay	Room	Wall	Metal	C		Intact	Gray
52	0.2	mg/cm2	Garage-4 Bay	Column		Metal	C		Intact	Brown
Exterior										
53	0	mg/cm2	Garage	Door	Frame	Metal	C		Intact	Gray
54	0	mg/cm2	Exterior	Room	Wall	Concrete	D		Intact	Gray
55	0	mg/cm2	Exterior	Room	Wall	Metal	C		Intact	Green

Table 2
Lead-Containing Paint Survey Summary and Results
Maine Turnpike Authority
150 Fletcher Street, Kennebunk, Maine

56	0.2	mg/cm2	Exterior - 8 Bay N	Room	Wall	Metal	A		Intact	Green
57	0.1	mg/cm2	Exterior - 8 Bay S	Room	Wall	Metal	A		Intact	Green
58	0	mg/cm2	Exterior - 8 Bay S	Room	Wall	Metal	C		Intact	Green
59	0.1	mg/cm2	Exterior - 8 Bay N	Room	Wall	Metal	C		Intact	Green
60	0	mg/cm2	Exterior	Room	Wall	Metal	C		Intact	White
61	0.9	mg/cm2	Calibration							
62	0.9	mg/cm2								
63	0.9	mg/cm2								
64	0	mg/cm2								
65	0	mg/cm2								
66	0	mg/cm2								

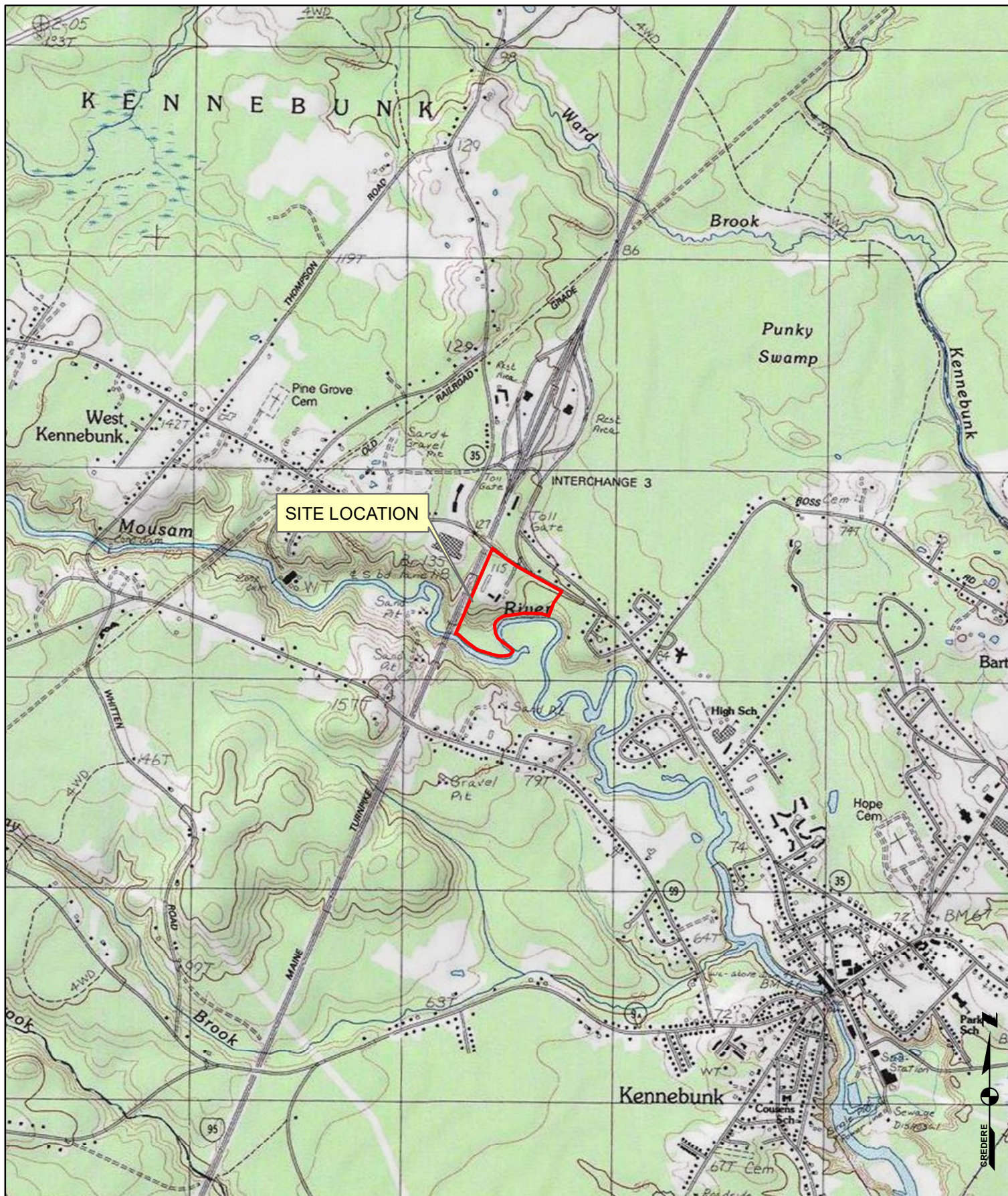
Notes:

mg/cm² - milligrams per centimeter squared

Bold indicates detectable concentrations of lead greater than 0.0 mg/cm2 but below 1.0 mg/cm2 (considered LCP)

FIGURES





DRAWN BY: PCH DATE: 12/23/2025
 CHECKED BY: AMK PROJECT: 25002060

FIGURE 1 SITE LOCATION PLAN



Credere Associates, LLC

776 MAIN STREET
 WESTBROOK, MAINE
 Tel. 207.828.1272
 Fax 207.887.1051
 WWW.CREDERELLC.COM

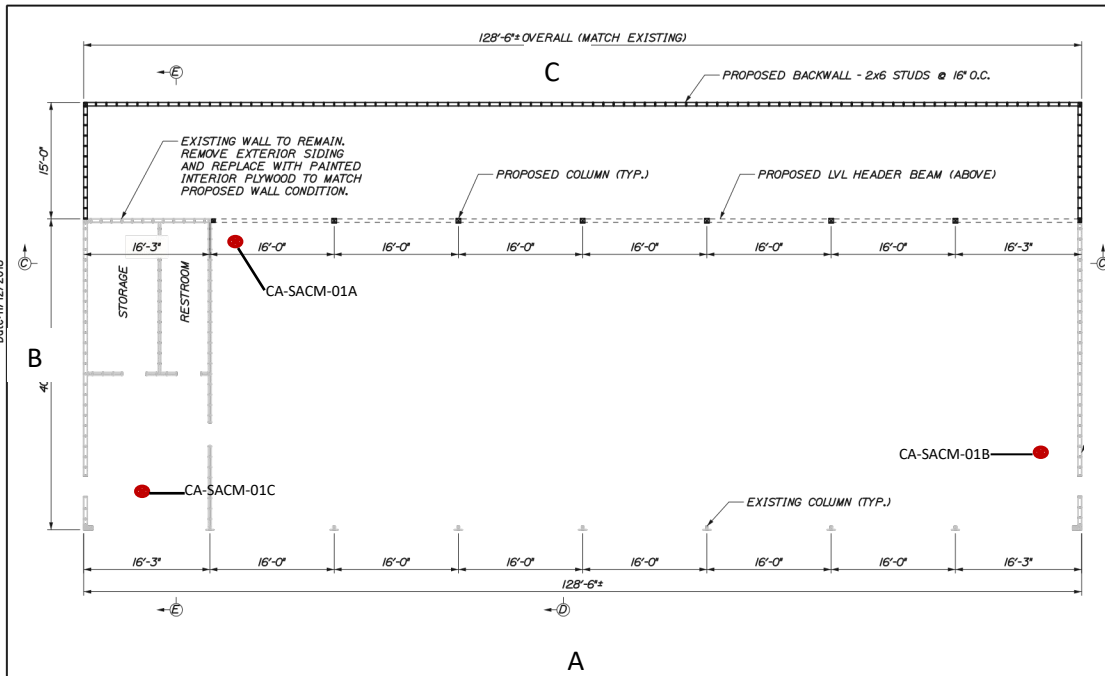
MAINE TURNPIKE AUTHORITY
 150 FLETCHER STREET
 KENNEBUNK, MAINE

1,000 0 2,000
 Feet
 1 INCH = 2,000 FEET



Date: 11/12/2018

Filename: 015_Proposed Modification Details_Kenn_1.dgn



● Sample for ACM Collected

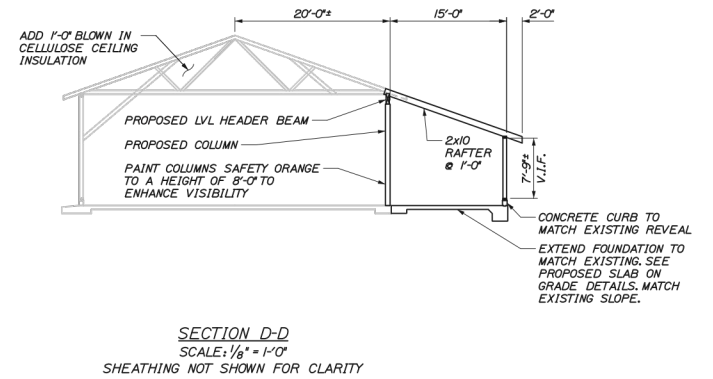
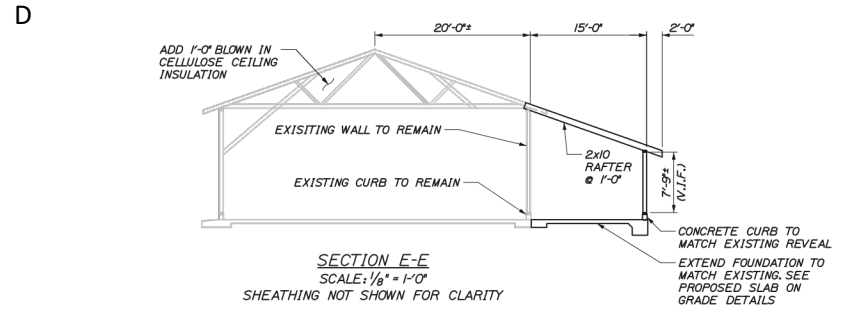
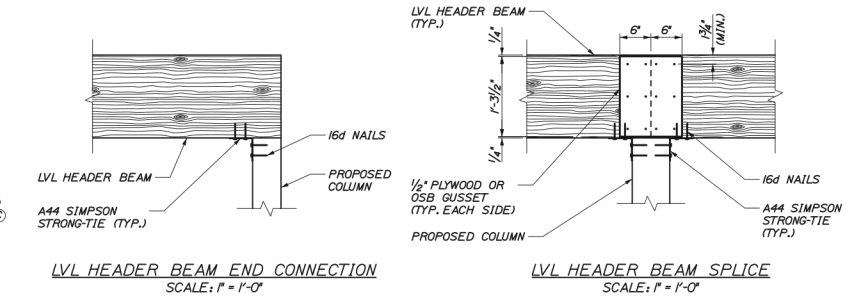


Figure 2 - HBMS Locations- 8 Bay North

Scale:				Designed by:				HNTB HNTB CORPORATION 340 County Road, Suite 6-C Westbrook, ME 04092 TEL (207) 774-5155 FAX (207) 228-0909				MAINE TURNPIKE THE GOLD STAR MEMORIAL HIGHWAY MTA PROJECT MANAGER: BRIAN TADDEO, PE		MAINTENANCE GARAGE EXTENSIONS PROPOSED MODIFICATION DETAILS (KENNEBUNK #1) KENNEBUNK SHEET NUMBER: S14 CONTRACT: 2018.23 15 OF 58	
No.	Revision	By	Date	CONSULTANT PROJECT MANAGER: BRUCE MUNGER, PE											
				By	Date	Checked	By	Date							
				Designed	BRG	11\17	RBM	11\17							
				Drawn	ERB	11\17	In Charge of	RAL	11\17						



1. SEE SHEET S21, S22, AND S23 FOR PROPOSED SLAB-ON-GRADE DETAILS.

2. SEE SHEET S24 FOR PROPOSED COLUMN AND HEADER DETAILS.

Scale:				Designed by:				HNTB HNTB CORPORATION 340 County Road, Suite 6-C Westbrook, ME 04092 TEL (207) 774-5155 FAX (207) 228-9909				MAINE TURNPIKE THE GOLD STAR MEMORIAL HIGHWAY MTA PROJECT MANAGER: BRIAN TADDEO, PE				MAINTENANCE GARAGE EXTENSIONS PROPOSED MODIFICATION DETAILS (KENNEBUNK #2) SHEET NUMBER: S16			
No.	Revision		By	Date	CONSULTANT PROJECT MANAGER: BRUCE MUNGER, PE								CONTRACT: 2018.23						
					By	Date	By	Date					17 OF 58						
					Designed	BRG 11\17	Checked	RBM 11\17											
					Drawn	ERB 11\17	In Charge of	RAL 11\17											

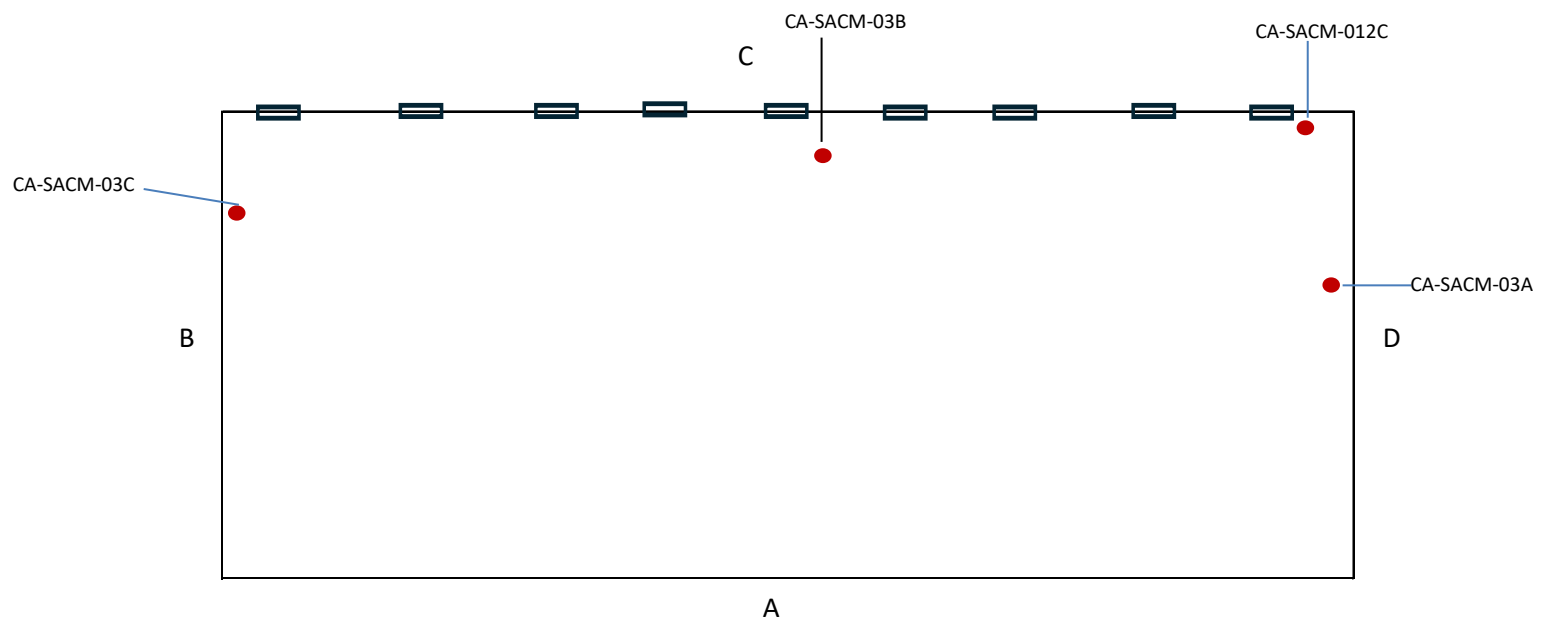
BULK BUILDING MATERIAL SAMPLING LOG, FIELD FIGURE
CREDERE ASSOCIATES, LLC

2

PROJECT NAME: Maine Turnpike Authority 159 Fletcher Street

PROJECT NUMBER: 25002060

DATE: November 20, 2025



10 Bag Garage

● Sample Location for SACM



Figure 4 - HBMS Locations- 10 Bay Garage

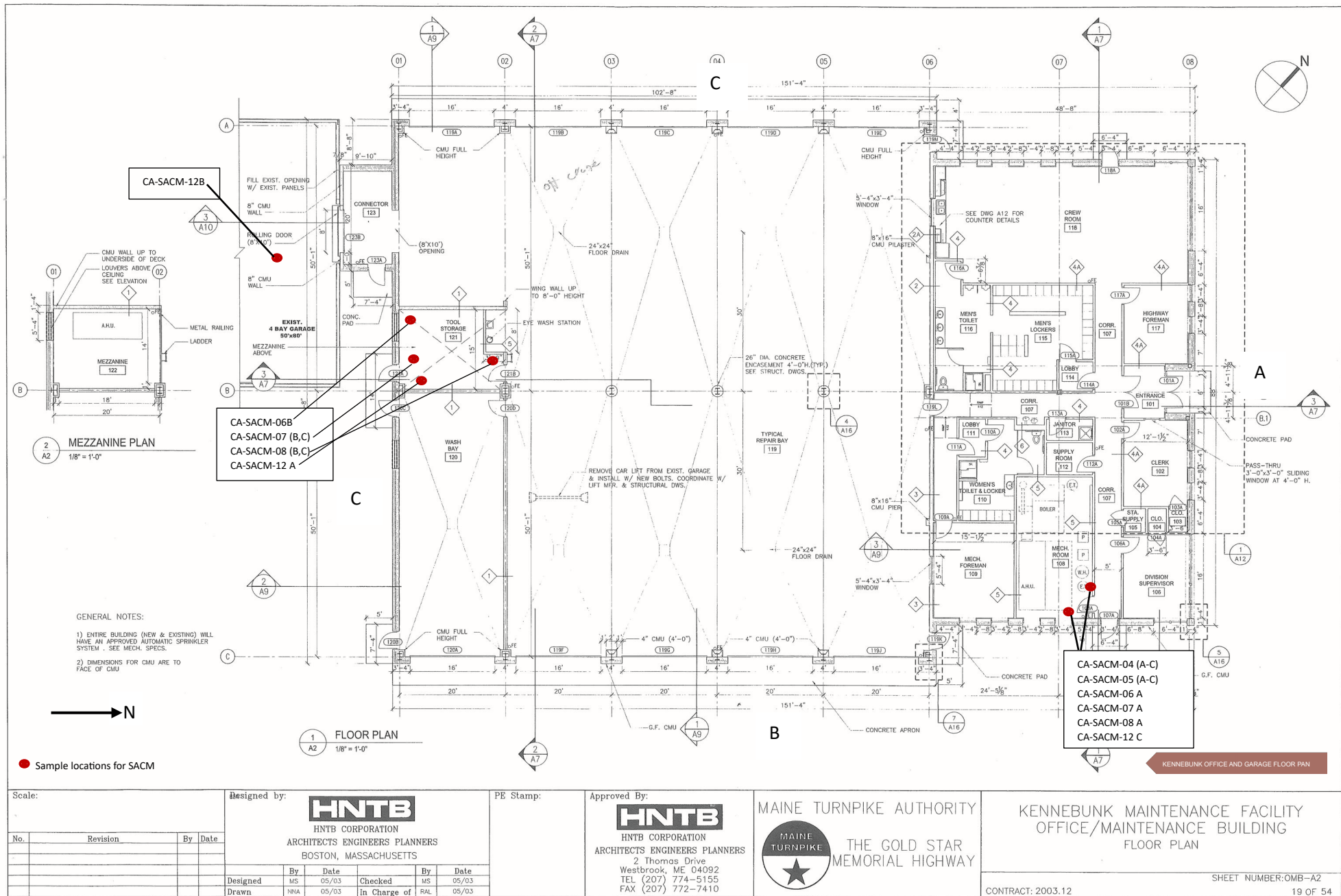


Figure 5- -HBMS Locations - Office and Maintenance Buildings

APPENDIX A

INSPECTOR CERTIFICATION DOCUMENTS



JANET T. MILLS
GOVERNOR

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION



MELANIE LOYZIM
COMMISSIONER

April 22, 2025

Eurofins ARA
124 Heritage Ave Unit 16
Portsmouth, NH 03801

Dear Licensee:

Asbestos application(s) for individual certification of the **one** employee(s) listed below have been received and **approved**. Individual certification numbers are listed below and wallet card(s) are enclosed. Card(s) are property of the individual to whom each is issued. Your responsibility as a licensee is to ensure delivery of the cards to persons in your employment. This letter should be retained for your company files as record of certification. **Please attach 1 updated passport size photo with every application.**

Remember, in Maine all **certified employees** working on an asbestos abatement project, whether conducting removal/repair, air monitoring, design, inspection, or analysis functions, **must work for a State of Maine licensed asbestos firm** and carry his/her wallet card(s) on the job site.

As a reminder, prior to renewing your asbestos certification, the State of Maine **requires** an annual refresher course to be taken before submitting a renewal application. A certificate shall expire one year from the last day of the month from the date of issuance, **or on the last day of the month that the training certificate expires**, whichever is sooner.

All our asbestos forms can be found at <https://www.maine.gov/dep/waste/asbestos/forms.html>
Thank you for your cooperation and your completed application(s).

<u>Name</u>	<u>Category</u>	<u>Certification #</u>	<u>Exp. Date</u>
Alison M. Keith	Inspector	AI-0743	4/30/2026

Sincerely,

Sandra J. Moody, Environmental Specialist
Division of Remediation
Bureau of Remediation and Waste Management

AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
(207) 941-4570 FAX: (207) 941-4584

website: www.maine.gov/dep



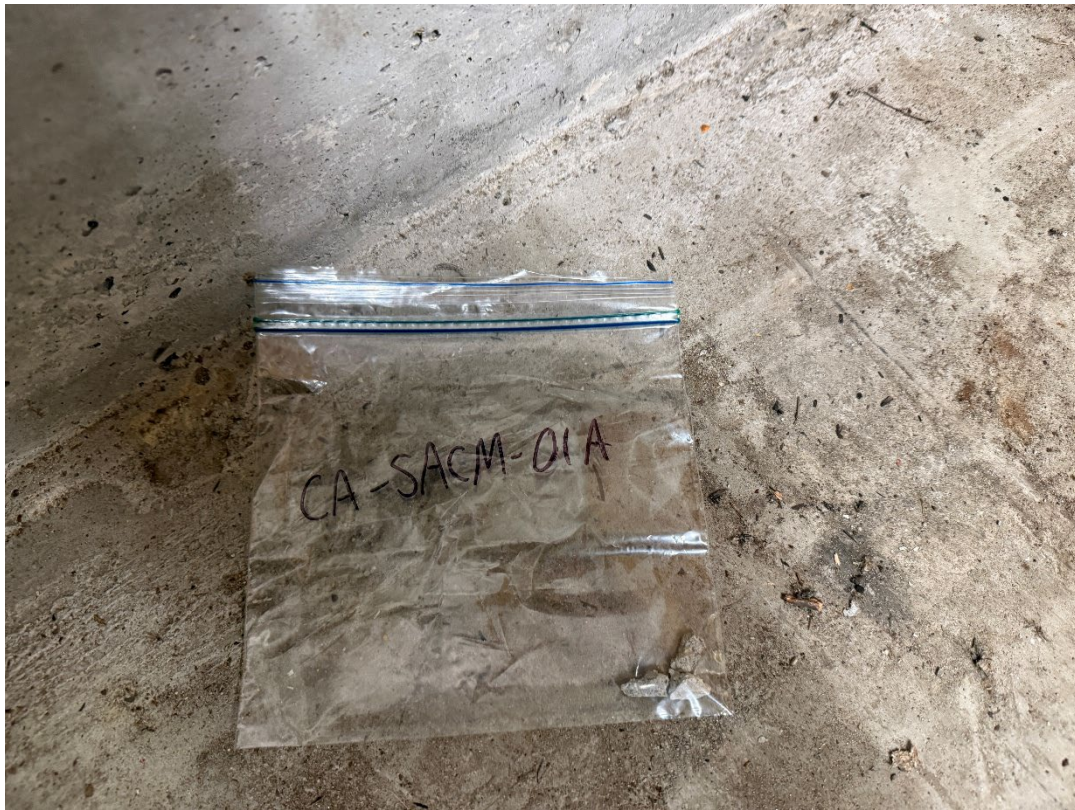
AY PARK

143

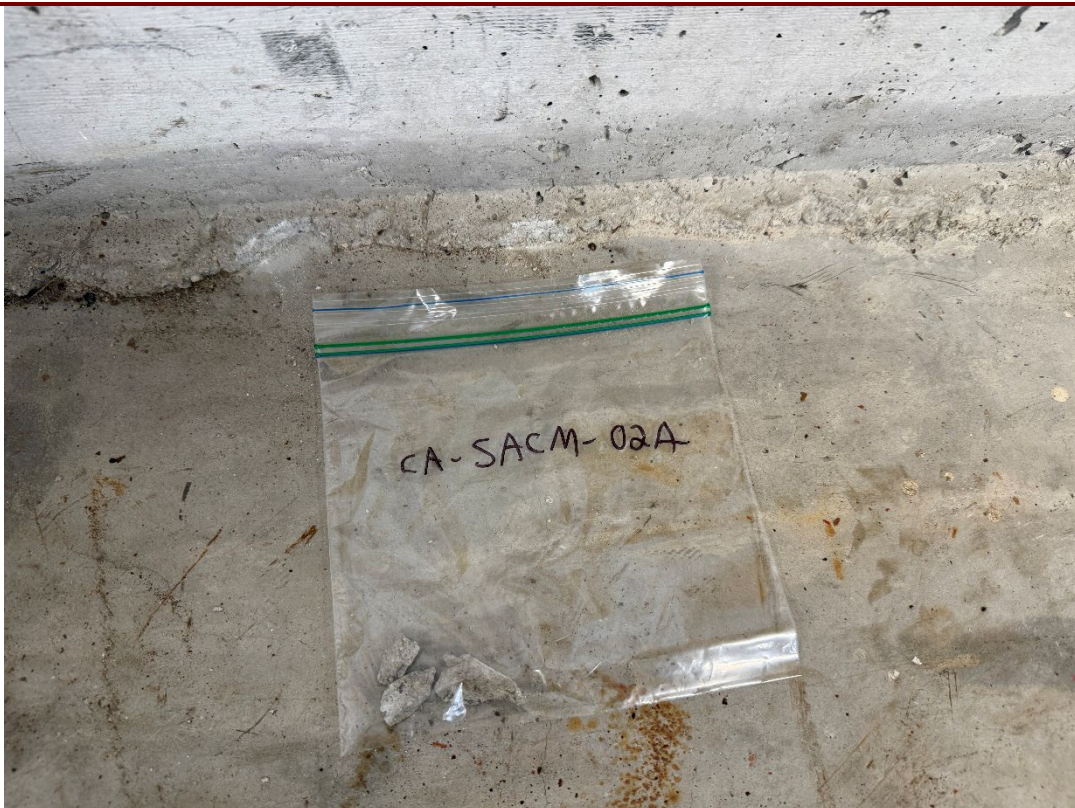
APPENDIX B

PHOTOGRAPH LOG

Appendix B – Photograph Log
Maine Turnpike Authority
150 Fletcher Street
Kennebunk, Maine

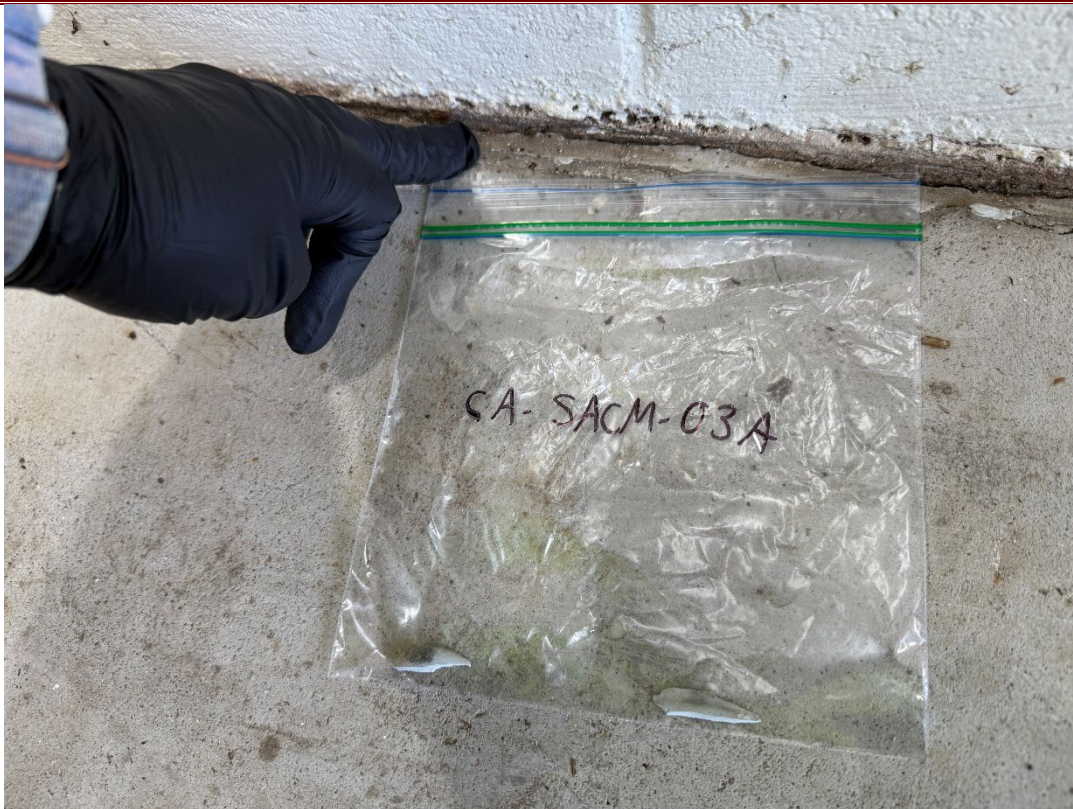


1. View of CA-SACM-01, concrete floor, gray

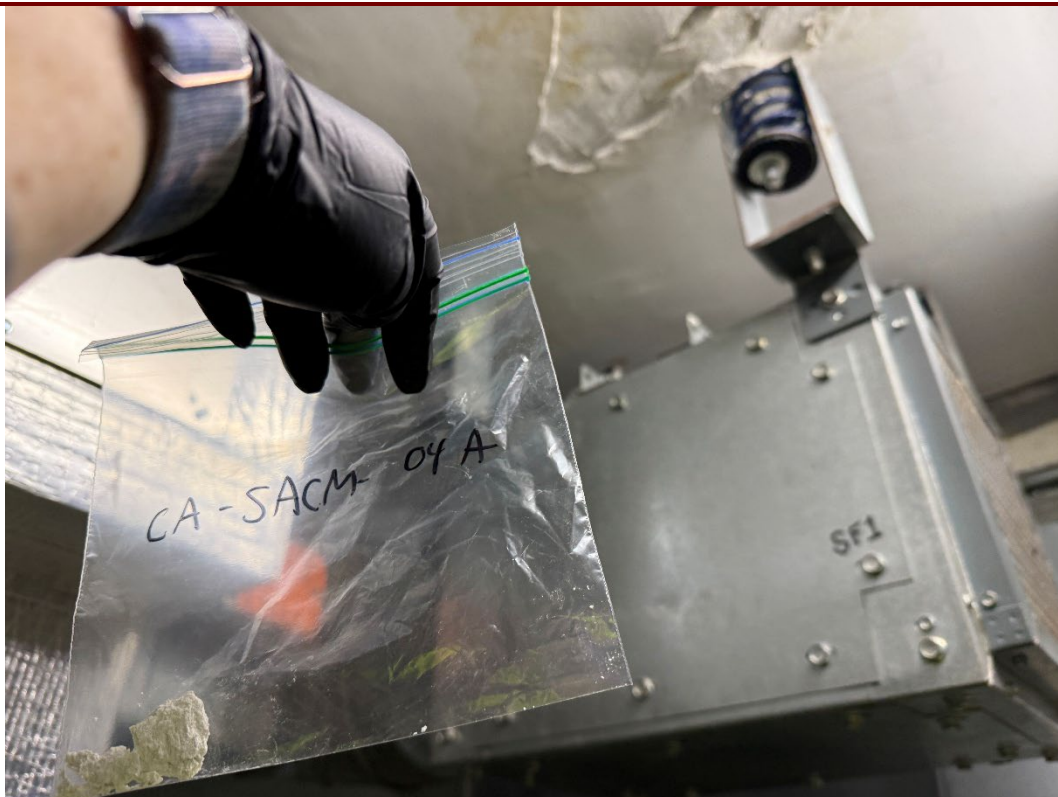


2. View of CA-SACM-02, concrete floor, gray

Appendix B – Photograph Log
Maine Turnpike Authority
150 Fletcher Street
Kennebunk, Maine

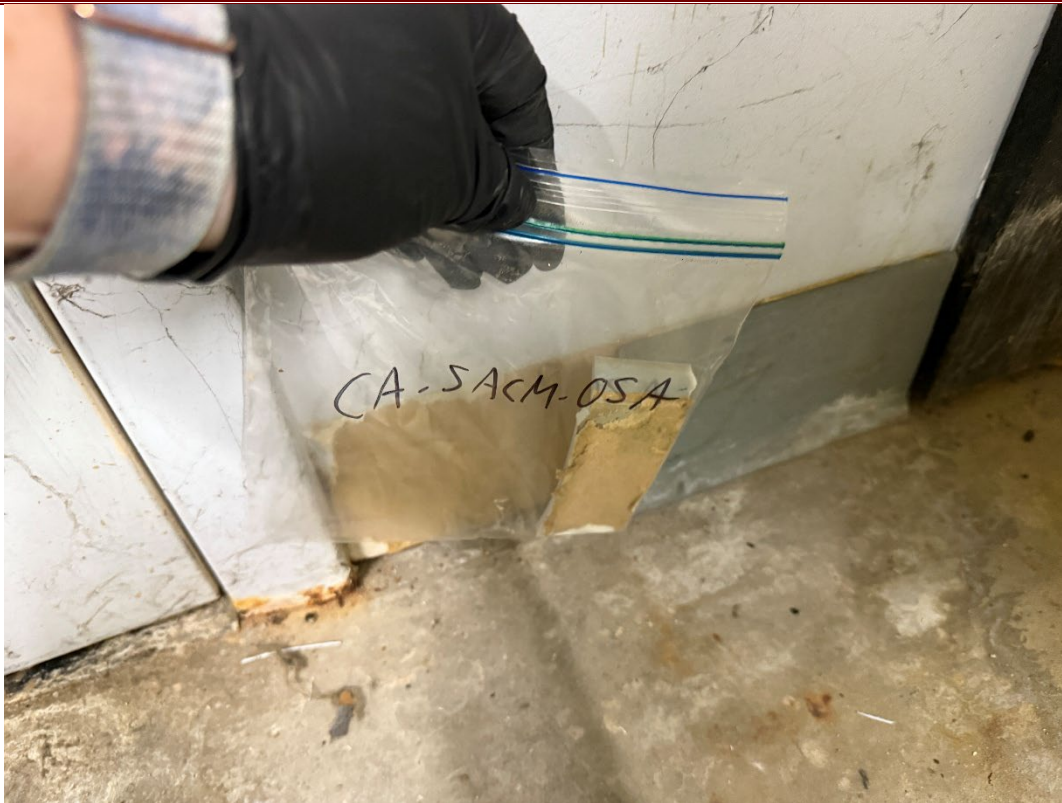


3. View of CA-SACM-03, floor caulking, gray

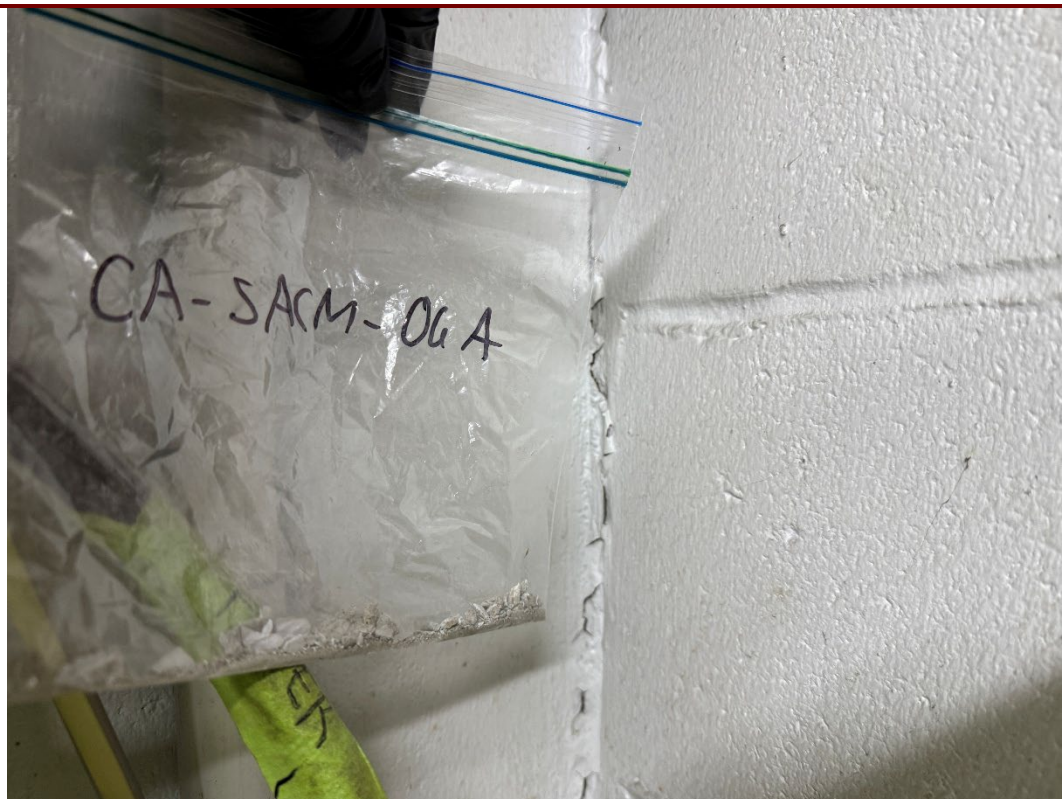


4. View of CA-SACM-04, sheetrock, light gray

Appendix B – Photograph Log
Maine Turnpike Authority
150 Fletcher Street
Kennebunk, Maine

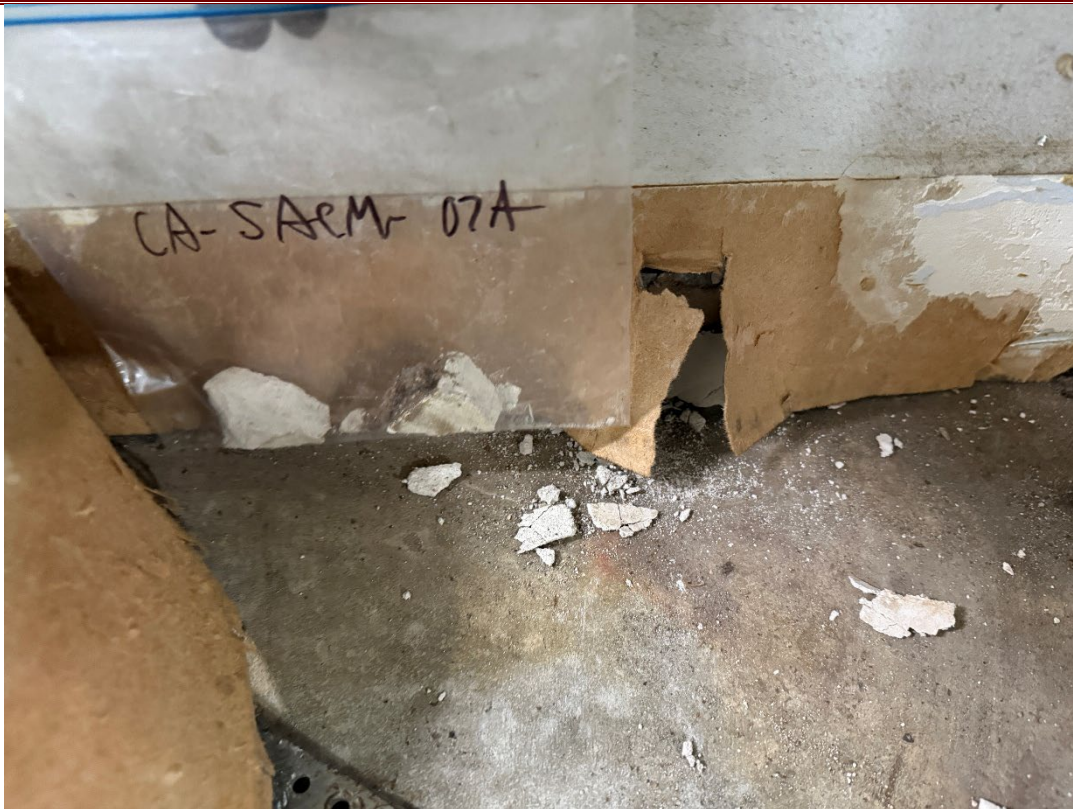


5. View of CA-SACM-05, cove base mastic, yellow

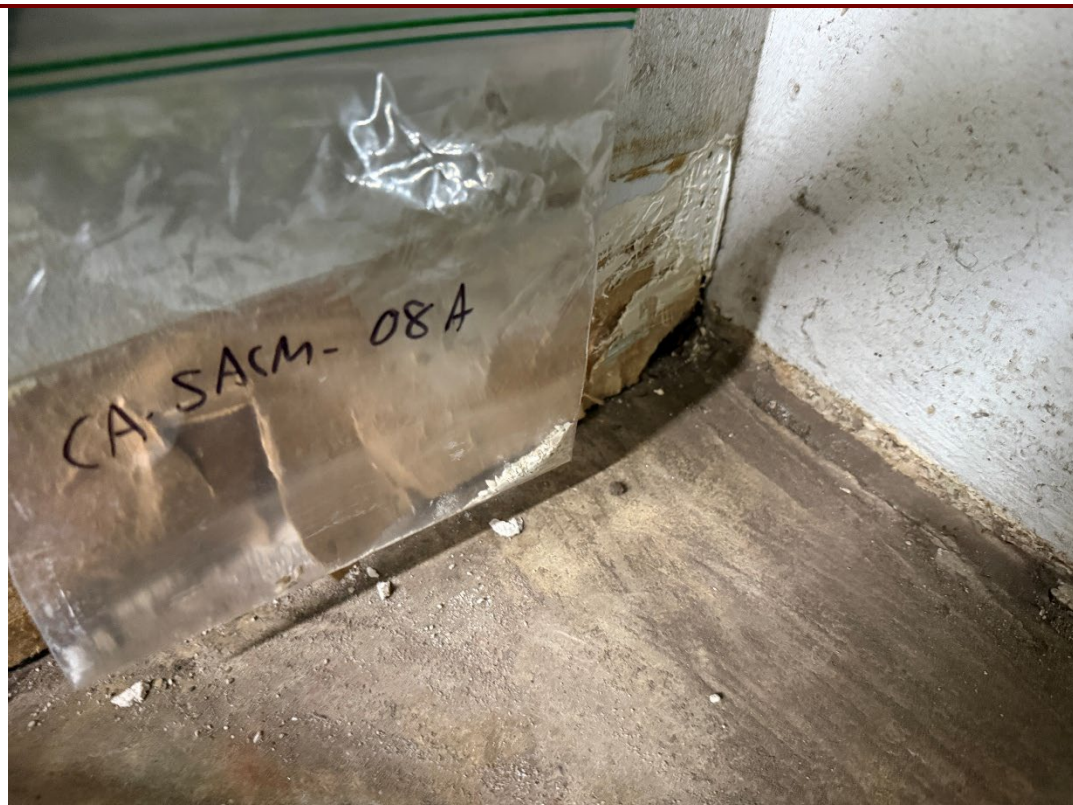


6. View of CA-SACM-06, CMU Mortar, gray

Appendix B – Photograph Log
Maine Turnpike Authority
150 Fletcher Street
Kennebunk, Maine



7. View of CA-SACM-07, sheetrock, light gray

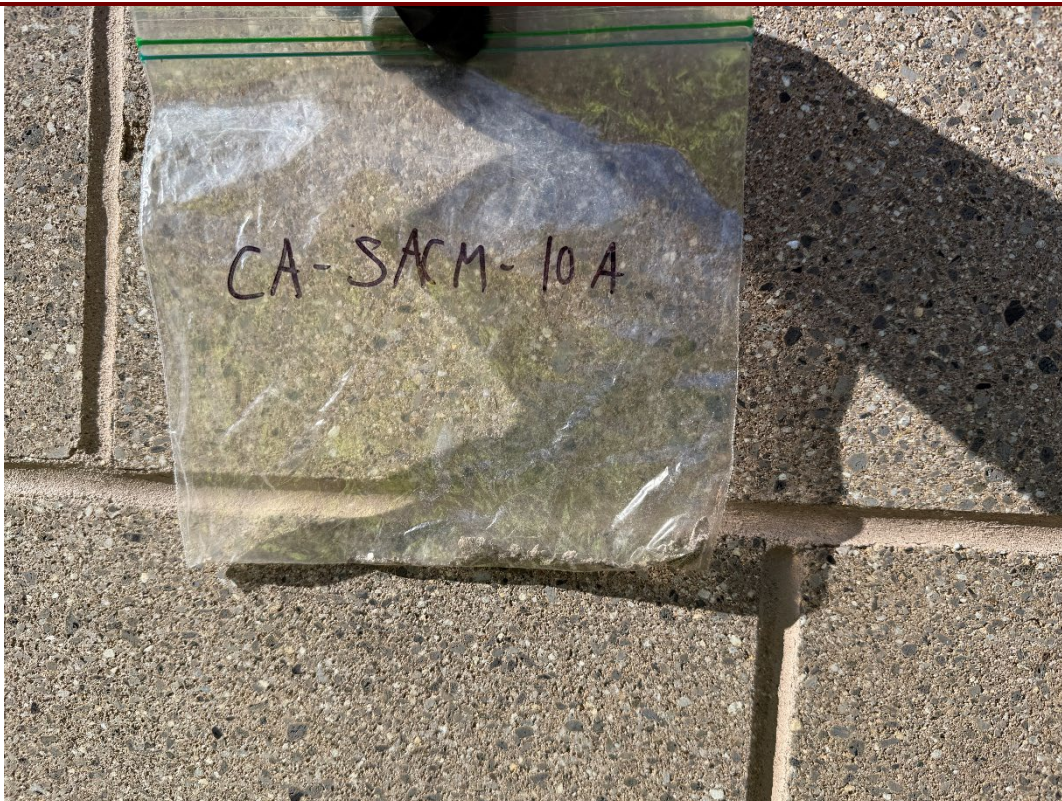


8. View of CA-SACM-08, joint compound, white

Appendix B – Photograph Log
Maine Turnpike Authority
150 Fletcher Street
Kennebunk, Maine



9. View of CA-SACM-09, expansion joint caulk, gray



10. View of CA-SACM-10, CMU mortar, gray

Appendix B – Photograph Log
Maine Turnpike Authority
150 Fletcher Street
Kennebunk, Maine



11. View of CA-SACM-11, concrete, gray



12. View of CA-SACM-12, concrete, gray

APPENDIX C

ANALYTICAL LABORATORY REPORTS



EMSL Analytical, Inc.

161 John Roberts Road South Portland, ME 04106
Phone/Fax: (207) 517-6921 / (207) 517-6922
<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622502001
Customer ID: CRED25
Customer PO:
Project ID:

Attn: Alison Keith
Credere Associates, LLC
776 Main Street
Westbrook, ME 04092

Phone: (204) 828-1272
Fax: (207) 887-1051
Collected: 11/20/2025
Received: 12/05/2025
Analyzed: 12/22/2025

Proj: 25002060 / Colby MTA Kennebunk

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CA-SACM-01A **Lab Sample ID:** 622502001-0001

Sample Description: 8 Bay North Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/09/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-01B **Lab Sample ID:** 622502001-0002

Sample Description: 8 Bay North Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/09/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-01C **Lab Sample ID:** 622502001-0003

Sample Description: 8 Bay North Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/09/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-02A **Lab Sample ID:** 622502001-0004

Sample Description: 8 Bay South Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/09/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-02B **Lab Sample ID:** 622502001-0005

Sample Description: 8 Bay South Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/09/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-02C **Lab Sample ID:** 622502001-0006

Sample Description: 8 Bay South Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/09/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-03A **Lab Sample ID:** 622502001-0007

Sample Description: 10 Bay Garage Floor/Caulk, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Gray	0.0%	100%	None Detected	



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161 John Roberts Road South Portland, ME 04106
Phone/Fax: (207) 517-6921 / (207) 517-6922
<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622502001
Customer ID: CRED25
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CA-SACM-03B **Lab Sample ID:** 622502001-0008

Sample Description: 10 Bay Garage Floor/Caulk, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Gray	0.0%	100%	None Detected	

Client Sample ID: CA-SACM-03C **Lab Sample ID:** 622502001-0009

Sample Description: 10 Bay Garage Floor/Caulk, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Gray	0.0%	100%	None Detected	

Client Sample ID: CA-SACM-04A **Lab Sample ID:** 622502001-0010

Sample Description: Office Mechanical Room/Sheetrock, Light Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-04B **Lab Sample ID:** 622502001-0011

Sample Description: Office Mechanical Room/Sheetrock, Light Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	White	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-04C **Lab Sample ID:** 622502001-0012

Sample Description: Office Mechanical Room/Sheetrock, Light Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	White	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-05A **Lab Sample ID:** 622502001-0013

Sample Description: Office Mechanical Room/Cove Base Mastic, Yellow

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Yellow	0.0%	100%	None Detected	

Client Sample ID: CA-SACM-05B **Lab Sample ID:** 622502001-0014

Sample Description: Office Mechanical Room/Cove Base Mastic, Yellow

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Yellow	0.0%	100%	None Detected	

Client Sample ID: CA-SACM-05C **Lab Sample ID:** 622502001-0015

Sample Description: Office Mechanical Room/Cove Base Mastic, Yellow

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Yellow	0.0%	100%	None Detected	



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<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622502001
Customer ID: CRED25
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CA-SACM-06A **Lab Sample ID:** 622502001-0016

Sample Description: Maintenance Building Tool Storage/CMU Mortar, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-06B **Lab Sample ID:** 622502001-0017

Sample Description: Maintenance Building Tool Storage/CMU Mortar, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-06C **Lab Sample ID:** 622502001-0018

Sample Description: Maintenance Building Tool Storage/CMU Mortar, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-07A **Lab Sample ID:** 622502001-0019

Sample Description: Maintenance Building Tool Storage/Sheetrock, Light Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	Gray	7.0%	93.0%	None Detected	

Client Sample ID: CA-SACM-07B **Lab Sample ID:** 622502001-0020

Sample Description: Maintenance Building Tool Storage/Sheetrock, Light Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	Gray	7.0%	93.0%	None Detected	

Client Sample ID: CA-SACM-07C **Lab Sample ID:** 622502001-0021

Sample Description: Maintenance Building Tool Storage/Sheetrock, Light Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	Gray	7.0%	93.0%	None Detected	

Client Sample ID: CA-SACM-08A **Lab Sample ID:** 622502001-0022

Sample Description: Maintenance Building Tool Storage/Joint Compound, White

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/19/2025	White	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-08B **Lab Sample ID:** 622502001-0023

Sample Description: Maintenance Building Tool Storage/Joint Compound, White

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	White	0.0%	100.0%	None Detected	



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EMSL Order ID: 622502001
Customer ID: CRED25
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CA-SACM-08C **Lab Sample ID:** 622502001-0024

Sample Description: Maintenance Building Tool Storage/Joint Compound, White

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	White	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-09A **Lab Sample ID:** 622502001-0025

Sample Description: 10 Bay Garage/Expansion Joint Caulk, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Gray	0.0%	100%	None Detected	

Client Sample ID: CA-SACM-09B **Lab Sample ID:** 622502001-0026

Sample Description: 10 Bay Garage/Expansion Joint Caulk, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Gray	0.0%	100%	None Detected	

Client Sample ID: CA-SACM-09C **Lab Sample ID:** 622502001-0027

Sample Description: 10 Bay Garage/Expansion Joint Caulk, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	12/19/2025	Gray	0.0%	100%	None Detected	

Client Sample ID: CA-SACM-10A **Lab Sample ID:** 622502001-0028

Sample Description: 10 Bay Garage/CMU Mortar, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-10B **Lab Sample ID:** 622502001-0029

Sample Description: 10 Bay Garage/CMU Mortar, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-10C **Lab Sample ID:** 622502001-0030

Sample Description: 10 Bay Garage/CMU Mortar, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-11A **Lab Sample ID:** 622502001-0031

Sample Description: 10 Bay Garage Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	



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EMSL Order ID: 622502001
Customer ID: CRED25
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CA-SACM-11B **Lab Sample ID:** 622502001-0032

Sample Description: 10 Bay Garage Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-11C **Lab Sample ID:** 622502001-0033

Sample Description: 10 Bay Garage Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-12A **Lab Sample ID:** 622502001-0034

Sample Description: Maintenance Building and 4 Bay Building Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-12B **Lab Sample ID:** 622502001-0035

Sample Description: Maintenance Building and 4 Bay Building Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CA-SACM-12C **Lab Sample ID:** 622502001-0036

Sample Description: Maintenance Building and 4 Bay Building Floor/Concrete, Gray

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	12/22/2025	Gray	0.0%	100.0%	None Detected	



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EMSL Order ID: 622502001
Customer ID: CRED25
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Analyst(s):

Anastasia Metzger PLM (27)
Mason Penn PLM Grav. Reduction (9)

Reviewed and approved by:

Erin Wright, Laboratory Director
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This is a summary report; official reports are available on LabConnect or upon request and relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. South Portland, ME NVLAP Lab Code 500094-0, VT AL197271, ME LM-0039, MA AA000236

Initial report from: 12/22/2025 12:04:55