

VALVOLINE INSTANT OIL CHANGE PROJECT MANUAL



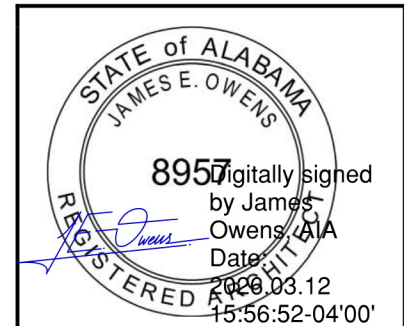
Cox Creek Parkway
Florence AL, 35630
03/18/26

Harrison French & Assoc. PLLC.
1705 S. Walton Blvd., Suite 3
Bentonville, AR 72712
Phone: 479-273-7780
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Project No. 06-25-20024

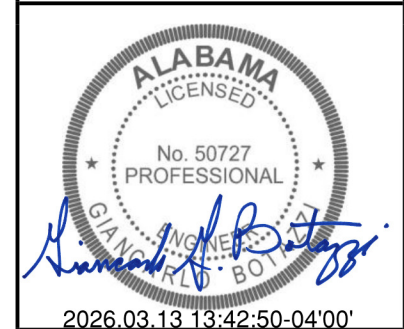
HFA

1.1 DESIGN PROFESSIONALS OF RECORD

ARCHITECT **James Owens**
Harrison French & Assoc. PLLC
31 Hayward St. Suite E-1
Franklin, MA 02038
Ph: 508-528-0770 ext 403



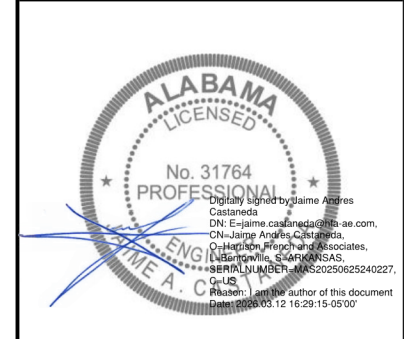
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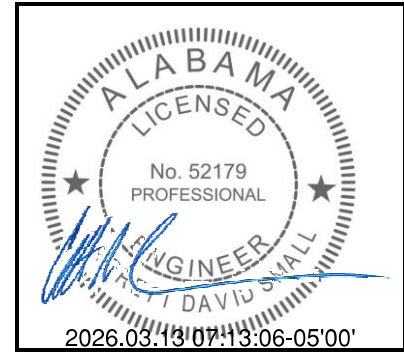


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Envelope Compliance Certificate

Project Information

Energy Code: 90.1 (2013) Standard
Project Title: VIOC - Florence AL - 2B Flat - 2013 90.1
Location: Florence, Alabama
Climate Zone: 3a
Project Type: New Construction
Vertical Glazing / Wall Area: 14%
Performance Sim. Specs: EnergyPlus 8.1.0.009 (EPW: USA_AL_Huntsville.Intl.AP-Jones.Field.723230_TMY3.epw)

Construction Site: Valvoline Instant Oil Change
Florence, Alabama

Owner/Agent: Valvoline Instant Oil Change
100 Valvoline Way
Lexington, Kentucky 40509

Designer/Contractor: HARRISON FRENCH AND ASSOCIATES LLC
1705 S. Walton Blvd Suit 3
Bentonville, Arkansas 72712

Building Area

Floor Area

1-Automotive Facility : Nonresidential

2673

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U- Factor ^(a)
Roof (Carlisle - SureWeld White: Insulation Entirely Above Deck, 3-Year-Aged Solar Reflectance = 0.70, Thermal Emittance = 0.86, [Bldg. Use 1 - Automotive Facility]	1333	---	28.5	0.034	0.039
Floor: Unheated Slab-On-Grade, [Bldg. Use 1 - Automotive Facility] (d)	185	---	---	0.730	0.730
NORTHEAST					
Exterior Wall - Tower Side: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Automotive Facility]	537	21.0	10.0	0.036	0.089
Window: Other Window: Fixed, Perf. Specs.: Product ID Solarban 70 Low E, SHGC 0.27, VT 0.64, [Bldg. Use 1 - Automotive Facility] (c)	40	---	---	0.350	0.350
Basement - Side: Solid Concrete, 10in. Thickness, Medium Density, Furring: None, Wall Ht 8.9, Depth B.G. 8.9, [Bldg. Use 1 - Automotive Facility]	274	---	0.0	0.500	0.579
SOUTHEAST					
Exterior Wall - Front: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Automotive Facility]	846	21.0	10.0	0.036	0.089
Window 1: Other Window: Fixed, Perf. Specs.: Product ID Solarban 70 Low E, SHGC 0.27, VT 0.64, [Bldg. Use 1 - Automotive Facility] (c)	26	---	---	0.350	0.350
Door 1: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: Product ID Solarban 70 Low E, SHGC 0.27, VT 0.64, [Bldg. Use 1 - Automotive Facility] (c)	24	---	---	0.350	0.770
Overhead Door 1: Glass (over 50 9.56976e-315lazing): Metal Frame, Non-Entrance Door, Perf. Specs.: Product ID Overhead Door - Model 521 - insulated, SHGC 0.32, VT 0.43, [Bldg. Use 1 - Automotive Facility] (c)	120	---	---	0.350	0.600

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U- Factor ^(a)
Overhead Door 2: Glass (over 50 9.56976e-315lazing): Metal Frame, Non-Entrance Door, Perf. Specs.: Product ID Overhea Door - Model 521 - insulated, SHGC 0.32, VT 0.43, [Bldg. Use 1 - Automotive Facility] (c)	120	---	---	0.350	0.600
Basement - Front: Solid Concrete, 10in. Thickness, Medium Density, Furring: None, Wall Ht 8.9, Depth B.G. 8.9, [Bldg. Use 1 - Automotive Facility]	423	---	0.0	0.500	0.579
SOUTHWEST					
Exterior Wall - Side: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Automotive Facility]	537	21.0	10.0	0.036	0.089
Basement - Side: Solid Concrete, 10in. Thickness, Medium Density, Furring: None, Wall Ht 8.9, Depth B.G. 8.9, [Bldg. Use 1 - Automotive Facility]	274	---	0.0	0.500	0.579
NORTHWEST					
Exterior Wall - Rear: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Automotive Facility]	823	21.0	10.0	0.036	0.089
Door 1: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: Product ID Solarban 70 Low E, SHGC 0.27, VT 0.64, [Bldg. Use 1 - Automotive Facility] (c)	24	---	---	0.350	0.770
Overhead Door 1: Glass (over 50 9.56976e-315lazing): Metal Frame, Non-Entrance Door, Perf. Specs.: Product ID Overhea Door - Model 521 - insulated, SHGC 0.32, VT 0.43, [Bldg. Use 1 - Automotive Facility] (c)	120	---	---	0.350	0.600
Overhead Door 2: Glass (over 50 9.56976e-315lazing): Metal Frame, Non-Entrance Door, Perf. Specs.: Product ID Overhea Door - Model 521 - insulated, SHGC 0.32, VT 0.43, [Bldg. Use 1 - Automotive Facility] (c)	120	---	---	0.350	0.600
Basement - Rear: Solid Concrete, 10in. Thickness, Medium Density, Furring: None, Wall Ht 8.9, Depth B.G. 8.9, [Bldg. Use 1 - Automotive Facility]	423	---	0.0	0.500	0.579

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.

(b) 'Other' components require supporting documentation for proposed U-factors.

(c) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.

(d) Slab-On-Grade proposed and budget U-factors shown in table are F-factors.

Envelope PASSES: Design 4% better than code

Envelope Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed envelope systems have been designed to meet the 90.1 (2013) Standard requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title

Signature

Date



Inspection Checklist

Energy Code: 90.1 (2013) Standard

Requirements: 0.0% were addressed directly in the COMcheck software

Text in the "Comments/Assumptions" column is provided by the user in the COMcheck Requirements screen. For each requirement, the user certifies that a code requirement will be met and how that is documented, or that an exception is being claimed. Where compliance is itemized in a separate table, a reference to that table is provided.

Section # & Req.ID	Plan Review	Complies?	Comments/Assumptions
4.2.2, 5.4.3.1.1, 5.7 [PR1] ¹	Plans and/or specifications provide all information with which compliance can be determined for the building envelope and document where exceptions to the standard are claimed.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
4.2.2, 8.4.1.1, 8.4.1.2, 8.7 [PR6] ²	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the electrical systems and equipment and document where exceptions are claimed. Feeder connectors sized in accordance with approved plans and branch circuits sized for maximum drop of 3%.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.5.4.2.3 [PR7] ²	In buildings > 2,500 ft ² , any enclosed spaces directly under a roof with ceiling heights > 15 ft. and used as an office, lobby, atrium, concourse, corridor, storage (including nonrefrigerated warehouse), gymnasium, fitness/exercise area, playing area, gymnasium seating area, convention exhibit/event space, courtroom, automotive service, fire station engine room, manufacturing corridor/transition and bay areas, retail, library reading and stack areas, distribution/sorting area, transportation baggage and seating areas, or workshop, the following requirements apply: The daylight zone under skylights is >= half the floor area and (a) the skylight area to daylight zone is >= 3 percent with a skylight VT >= 0.40 or (b) the minimum skylight effective aperture >= 1 percent. The skylights have a measured haze value > 90 percent.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)

Section # & Req.ID	Footing / Foundation Inspection	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
4.2.4 [FO1] ²	Installed below-grade wall insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	R-_____	R-_____	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.8.1.2 [FO2] ²	Below-grade wall insulation installed per manufacturer's instructions.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
4.2.4 [FO3] ²	Installed slab-on-grade insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	R-_____ ☐ Unheated ☐ Heated	R-_____ ☐ Unheated ☐ Heated	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.8.1.2 [FO4] ²	Slab edge insulation installed per manufacturer's instructions.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.5.3.5 [FO5] ²	Slab edge insulation depth/length.	_____ ft	_____ ft	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.8.1.7 [FO6] ¹	Exterior insulation protected against damage, sunlight, moisture, wind, landscaping and equipment maintenance activities.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.1.7.3 [FO7] ¹	Insulation in contact with the ground has <=0.3% water absorption rate per ASTM C272.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
6.4.4.1.5 [FO11] ³	Bottom surface of floor structures incorporating radiant heating insulated to >=R-3.5.	R-_____	R-_____	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)

Section # & Req.ID	Framing / Rough-In Inspection	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
5.4.3.2 [FR1] ³	Factory-built and site-assembled fenestration and doors are labeled or certified as meeting air leakage requirements.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.5.4.3a [FR8] ¹	Vertical fenestration U-Factor.	U-____	U-____	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.5.4.3b [FR9] ¹	Skylight fenestration U-Factor.	U-____	U-____	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.5.4.4.1 [FR10] ¹	Vertical fenestration SHGC value.	SHGC:____	SHGC:____	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.5.4.4.2 [FR11] ¹	Skylight SHGC value.	SHGC:____	SHGC:____	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.8.2.1, 5.8.2.3, 5.8.2.4, 5.8.2.5 [FR12] ²	Fenestration products rated (U-factor, SHGC, and VT) in accordance with NFRC or energy code defaults are used.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.2.2 [FR13] ¹	Fenestration and door products are labeled, or a signed and dated certificate listing the U-factor, SHGC, VT, and air leakage rate has been provided by the manufacturer.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.5.3.6 [FR14] ²	U-factor of opaque doors associated with the building thermal envelope meets requirements.	U-____ ☐ Swinging ☐ Nonswinging	U-____ ☐ Swinging ☐ Nonswinging	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.4.3.1 [FR15] ¹	Continuous air barrier is wrapped, sealed, caulked, gasketed, and/or taped in an approved manner, except in semiheated spaces in climate zones 1-6.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)

Section # & Req.ID	Rough-In Electrical Inspection	Complies?	Comments/Assumptions
8.4.2 [EL10] ²	At least 50% of all 125 volt 15- and 20-Amp receptacles are controlled by an automatic control device.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)

Section # & Req.ID	Insulation Inspection	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
4.2.4 [IN2] ¹	Installed roof insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports. For some ceiling systems, verification may need to occur during Framing Inspection.	R-____ ☐ Above deck ☐ Metal ☐ Attic	R-____ ☐ Above deck ☐ Metal ☐ Attic	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.8.1.2, 5.8.1.3 [IN3] ¹	Roof insulation installed per manufacturer's instructions. Blown or poured loose-fill insulation is installed only where the ceiling slope is <= 3:12.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
4.2.4 [IN6] ¹	Installed above-grade wall insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	R-____ ☐ Mass ☐ Metal ☐ Steel ☐ Wood	R-____ ☐ Mass ☐ Metal ☐ Steel ☐ Wood	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.8.1.2 [IN7] ¹	Above-grade wall insulation installed per manufacturer's instructions.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
4.2.4 [IN8] ²	Installed floor insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	R-____ ☐ Mass ☐ Steel ☐ Wood	R-____ ☐ Mass ☐ Steel ☐ Wood	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
5.8.1.1 [IN10] ²	Building envelope insulation is labeled with R-value or insulation certificate has been provided listing R-value and other relevant data.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.1.9 [IN18] ²	Building envelope insulation extends over the full area of the component at the proposed rated R or U value.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.1.4 [IN11] ²	Eaves are baffled to deflect air to above the insulation.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.1.5 [IN12] ²	Insulation is installed in substantial contact with the inside surface separating conditioned space from unconditional space.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.1.6 [IN13] ²	Recessed equipment installed in building envelope assemblies does not compress the adjacent insulation.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.1.7.1 [IN15] ²	Attics and mechanical rooms have insulation protected where adjacent to attic or equipment access.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

1 High Impact (Tier 1) 2 Medium Impact (Tier 2) 3 Low Impact (Tier 3)

Section # & Req.ID	Insulation Inspection	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
5.8.1.7.2 [IN16] ²	Foundation vents do not interfere with insulation.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
5.8.1.8 [IN17] ³	Insulation intended to meet the roof insulation requirements cannot be installed on top of a suspended ceiling. Mark this requirement compliant if insulation is installed accordingly.			☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)

Section # & Req.ID	Final Inspection	Complies?	Comments/Assumptions
5.4.3.3 [FI1] ¹	Weatherseals installed on all loading dock cargo doors in Climate Zones 4-8.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)

VALVOLINE INSTANT OIL CHANGE PROJECT MANUAL

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CONSTRUCTION CONTRACT

This CONSTRUCTION CONTRACT ("Contract") is made as of the _____ day of _____, 20____, by and between _____, a _____, having an address of _____ (the "Contractor"), and **VALVOLINE LLC**, a Delaware limited liability company, having an address of 100 Valvoline Way, Lexington, Kentucky 40509 (the "Owner").

RECITALS:

WHEREAS, the Owner is the [owner/lessee] of that certain property located in the City of _____, County of _____, State of _____, with an address of _____; on which Owner [operates/intends to operate] a "Valvoline Instant Oil Change Facility" (the "Project"); and

WHEREAS, the Owner has retained _____ to prepare certain architectural and engineering drawings, plans and specifications for the Project, a copy of which are attached hereto as EXHIBIT A (as the same may be amended from time to time in accordance herewith, the "Plans and Specifications"); and

WHEREAS, the Owner has agreed to retain the Contractor, and the Contractor has agreed, to perform all work necessary to complete the Project depicted in the Plans and Specifications on the terms and conditions set forth herein.

NOW THEREFORE, for and in consideration of good and valuable consideration, the receipt of which is hereby acknowledged, the Contractor and the Owner covenant and agree as follows:

I. EXECUTION.

This Contract shall be executed through DocuSign electronic signature software, which shall be deemed original signatures and which the parties acknowledge shall be binding and effective.

2. CONTRACT DOCUMENTS.

The following documents (together with this Contract, the "Contract Documents") are attached hereto and incorporated into the Contract:

- Exhibit A: Plans and Specifications;
- Exhibit B: Schedule of Values; and
- Exhibit C: As-Built Document Requirements.

To the extent of any direct conflict or inconsistency between any of the Contract Documents, the Contractor shall immediately seek clarification from the Owner in writing. In the event that the Owner fails to clarify such conflict or inconsistency, within a reasonable time under the

circumstances, the Contractor shall proceed with the Work and give precedence to the Contract Documents in the following order of priority:

- (i) Amendments or Change Orders issued after execution of this Contract;
- (ii) This Contract;
- (iii) Addenda issued prior to the execution of the Contract, with the Addenda bearing the latest date taking precedence;
- (iv) The Specifications; and
- (vi) The Plans, except, and notwithstanding the foregoing priorities, in order of priority:

- (1) Legal Requirements shall take precedence over any conflicting or inconsistent provisions of the Contract Documents, except to the extent such Legal Requirements are specifically waived in the Contract and such waiver is authorized under such Legal Requirements;
- (2) if conflicts or inconsistencies exist among or between the Contract Documents and any information provided by a manufacturer, including, but not limited to, manufacturer's installation instructions, then the information provided by the manufacturer shall govern;
- (3) if conflicts or inconsistencies exist among the Contract Documents relating to (i) the quality of the Work to be performed, (ii) installation requirements for materials, or (iii) sequence of the Work, then the Specifications shall govern; provided, however, that, in each case, the most complete and detailed method of the Work and the higher quality shall govern, unless approval for the less complete and detailed method of the Work or lower quality has been given by the Owner in writing;
- (4) if conflicts or inconsistencies exist among the Contract Documents relating to (i) the quantity or location of materials, or (ii) the construction phases of the Work, then the Plans shall govern; provided, however, that, in each case, the larger quantity contained in the Contract Documents shall govern, unless approval for the smaller quantity has been given by the Owner in writing; and
- (5) if conflicts or inconsistencies exist among the Specifications and Plans relating to the extent of the Work to be performed, all work necessary for the execution of the Work, and any work reasonably inferable therein, shall be considered as part of the Contract and shall be executed by the Contractor in the same manner and with the same character and quality of material as other portions of the Work without any increase in Contract Sum or extension of the Contract Time.

3. SCOPE OF WORK.

- (a) The Contractor shall furnish and pay for all labor, materials, power, equipment, transportation, and all other items unless otherwise stipulated, necessary to complete the work and complete the Project as depicted in the Plans and Specifications (the "Work"). Where one or more certain materials, trade names, or articles of any certain manufacturer are mentioned in the Plans and Specifications, it is done for the express purpose of establishing a basis for durability, quality and efficiency, and variations from the Plans and Specifications are unacceptable, and other materials may be used only if (i) they are equal in durability, quality and efficiency to those mentioned in the Plans and Specifications and are in harmony with the Work and (ii) the Owner has given its prior written approval of any such variation, which may be withheld in Owner's sole discretion. Should any work which is not detailed herein be required in order to properly complete the Work to be done

hereunder, including any Work reasonably inferable from the Plans and Specifications, the Contractor shall perform all such work as if fully described herein.

(b) The Contractor shall provide a full-time, competent superintendent for this Project who will be assigned to the Project for the duration and will primarily be on-site. Execution of the Contract by the Contractor is a representation that the Contractor has visited and inspected the Project site, become familiar with local conditions under which the Work is to be performed (including, without limitation, the location, condition, layout, grades, elevations, dimensions, and nature of the Project site and surrounding areas; prevailing and seasonal climatic conditions; anticipated labor supply and costs; availability and costs of materials, tools, and equipment; and other similar issues), and correlated personal observations with requirements of the Contract Documents. The Contractor shall be solely responsible for providing and implementing all necessary or prudent safety precautions and programs for the performance of the Work. The Owner shall not be obligated to adjust either the Contract Sum or the Contract Time to compensate for any costs or delays incurred as a result of the failure of the Contractor or any Subcontractor to comply with the requirements of this Section.

(c) The Contractor shall maintain for Owner one copy of all Plans and Specifications, Contract Addenda, shop drawings, Field Work Orders, Change Orders, Construction Change Directives, and other modifications, in good order and marked to record all changes made during construction as applicable for the scope of work of the Project. No portion of Work requiring a shop drawing or sample submission shall be started until the submission has been approved by Owner in writing. The Contractor shall be held responsible for all mistakes or errors in shop drawings or samples.

(d) Contractor acknowledges that the Owner administers a Construction Materials Testing Program (the "CMT Program") and Contractor shall reasonably cooperate in the administration of such CMT Program.

4. PERMITS, LICENSES AND FEES.

The Contractor shall secure all trade permits and licenses necessary for the accomplishment of the Work and shall comply with all Legal Requirements and, if anything herein contained is at variance with any Legal Requirement, then the Contractor shall immediately notify the Owner and receive written instructions before proceeding with such Work. Prior to Contractor's application for a building permit, it shall secure Owner's written approval of the Project value to be used for permit purposes. The building permit and curb cut permit will be issued to the Contractor. The costs of such permits will be Owner's responsibility. At Owner's option, Owner may obtain any of the licenses or permits.

5. WARRANTY.

The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the

Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective (“Defective Work”). If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

(a) Contractor agrees to repair or replace, at Owner’s option, any Defective Work (including, without limitation, materials) for the later of: (i) the minimum time period as may be prescribed by the Legal Requirements, whether provided for in the Contract or not, or (ii) a period of one (1) year from Substantial Completion, unless a longer period is stated in the Plans and Specifications (collectively referred to as the “Warranty Period”). If Defective Work is latent, hidden or not normally observable, the Warranty Period shall extend for such period as may be specified under the Legal Requirements, and in any case, such period shall extend for no less than one (1) year from discovery of such Defective Work by the Owner.

(b) The Contractor agrees to meet with Owner and/or Owner’s representative within fourteen (14) days of the end of the eleventh month following Substantial Completion for an inspection of the Work to address any warranty issues. If Contractor fails to meet with Owner within said period, the Warranty Period shall be extended until the parties meet and Contractor has addressed such warranty issues. All deficiencies not caused by Owner, neglect, failure to maintain or normal wear and tear shall be noted, and a list of deficiencies shall be given to Contractor. Contractor agrees to correct all such deficiencies in accordance with paragraph (c) below.

(c) Contractor shall immediately evaluate any requests by Owner to repair or replace Defective Work and commence repairs within ten (10) days of Owner’s written request (or such other time as reasonably required by Owner based upon the condition and circumstances), and diligently pursue completion of any required repairs. Contractor shall immediately respond to emergencies raised by the Owner which arise during the Warranty Period. In the event of Contractor’s failure to initiate repairs to the Work within the time required or failure to complete the repairs to the Work in not less than thirty (30) days (unless Owner agrees in writing to such additional time as may be reasonably required due to the circumstances) Owner shall have the right, but not the obligation, to engage a third party to correct such defects or deficiencies in the Work, and Owner may deduct any costs incurred by Owner from amounts due or which may become due to the Contractor. If insufficient amounts are owed to Contractor, then Contractor shall immediately reimburse Owner, upon written demand, for all costs and damages incurred by Owner arising from the correction of such Work. The Warranty Period shall be extended for one year by corrective Work performed by the Contractor pursuant to this Section, such that the Warranty Period for any portion of the Work that is corrected by Contractor pursuant to this Section shall not expire until at least one year after the date of such corrective Work.

(d) Final payment, use of the improvements, or any other act of Owner shall not relieve the Contractor of his responsibility for latent or patent defects, faulty workmanship or materials. Owner agrees to give notice of observed defects with reasonable promptness.

(e) The Contractor shall have each subcontractor execute and deliver to Owner upon the earlier of (i) Substantial Completion; or (ii) termination of the Contract, a written guarantee covering all Work not performed by the Contractor and not guaranteed by any other party. The guarantee shall be for the Warranty Period. All third-party guarantees and warranties for the building materials and mechanical equipment included in the Project, and supplied by the Contractor, if any, such as, but not limited to, roofing system, electrical systems, plumbing systems, all mechanical equipment, the hot water heater, sump pump, H.V.A.C units, exhaust fans, door closures and water softeners and all other equipment and material with a guarantee, shall be delivered to Owner by the Contractor.

(f) The Contractor shall perform the Work consistent with and in such a manner so to fully preserve any and all manufacturer warranties relating to materials and equipment used on or installed in the Project and shall assign to the Owner at the time of Substantial Completion of the Work any and all such manufacturer warranties. Such assignment shall not relieve the Contractor of any warranty obligations, and the Contractor may retain the right to enforce directly any such manufacturer warranties.

6. CONTRACT TIME.

(a) The Owner shall issue a written “Notice to Proceed” with the Work (the date actually set forth in such Notice to Proceed shall be referred to herein as the “Start Date”).

The Contractor shall achieve Substantial Completion of the Work within Calendar days from the Start Date (such period from the Start Date to the Substantial Completion date, as the same may be amended from time to time, shall be referred to herein as the “Contract Time”).

The Contractor shall coordinate and expedite all long lead time materials and equipment to ensure Substantial Completion of the Work within the Contract Time. At the Contractor’s request, the Owner may direct the Contractor to purchase certain long lead time materials or equipment prior to a Notice to Proceed (a “Long Lead Time Order”). Any such Long Lead Time Order is incorporated into the Contract and subject to all other terms and conditions of this Contract. The Long Lead Time Order shall specify a reasonable markup for overhead and profit, storage, transportation, and any other costs to be paid by Owner to Contractor in the event of termination.

Contractor agrees that time is of the essence with respect to Contractor’s obligations hereunder. The Contractor shall staff the site and commence Work on the Start Date. If the Work is not commenced by the Contractor on the Start Date, the Owner reserves the right to terminate this Contract without payment of any funds to the Contractor, other than as specifically itemized in a Long Lead Time Order, if any.

Within seven (7) days of the execution of this Contract, the Contractor shall submit to the Owner the Project Schedule (the “Project Schedule”) for informational purposes only, which may be amended from time to time. To the extent of any direct conflict or

inconsistency between the Project Schedule and this Contract or the Notice to Proceed, this Contract and the Notice to Proceed shall take precedence.

(b) In no event shall Contractor commence the Work prior to receiving a Notice to Proceed. In the event Contractor commences construction without a Notice to Proceed, Owner shall be entitled to the amount of any damages and expenses related thereto, and the Contractor shall immediately cease the Work.

(c) Owner may at any time prior to issuing the Notice to Proceed to the Contractor, terminate this Contract without any obligation to the Contractor.

(d) As used herein, the term "Substantial Completion" shall mean that the Work is completed such that Owner determines it may occupy or use the Project and the Work for the use for which it is intended, subject only to the completion of the Punch List and the other items required in connection with Final Completion (as defined below).

7. PAYMENT.

(a) In consideration for the Contractor undertaking and performing the Work to be done hereunder, Owner agrees to pay the Contractor the sum of [REDACTED] Dollars (\$ [REDACTED]) (as the same may be amended from time to time, the "Contract Sum"). The Schedule of Values (the "Schedule of Values") attached hereto as EXHIBIT B is a line item breakdown of the Contract Sum amongst various components of the Work. The Contract Sum includes and Contractor shall pay, all federal, state, and local taxes, including sales taxes, excise taxes, use taxes, retailer's occupational taxes employment taxes, worker's compensation, overhead, and similar taxes.

(b) The Schedule of Values shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the Schedule of Values shall be submitted to the Owner and supported by such data to substantiate its accuracy as the Owner may require, and unless objected to by the Owner, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment. The Contractor shall submit to the Owner an itemized Application for Payment prepared in accordance with the Schedule of Values for completed portions of the Work. The period covered by each Application for Payment shall be one calendar month ending on the last day of the month. Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment. For each progress payment made, the Owner may withhold ten percent (10%) as retainage from the payment otherwise due.

(c) The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which payment has been made by Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work. Further, Contractor acknowledges that a

progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract.

(d) All Applications for Payment shall be accompanied by such supporting evidence as Owner may require, and shall show separately on their face a breakdown of labor, material costs, freight, if any, and sales tax, if any, covered by such Application for Payment. As a condition precedent to Owner's obligation to make any progress payment to Contractor, Contractor must deliver to Owner a completed contractor's sworn statement and lien waiver (on such form as is acceptable to Owner and in accordance with the Legal Requirements) signed and sworn to by Contractor.

(e) Owner's obligations to the Contractor shall be limited to the payment for labor, materials and supervision actually furnished by the Contractor under the terms of this Contract. All Applications for Payment shall be submitted to Owner signed by an authorized representative of the Contractor.

(f) Final payment may be requested when the store is open, all unfinished construction items (*i.e.*, the Punch List) completed, and the following items, in form and substance satisfactory to Owner, have been delivered to and approved by Owner (collectively, "Final Completion"):

(i) a completed form Contractor's sworn statement and final lien waiver signed and sworn to by Contractor and completed final lien waiver forms signed and sworn to by all subcontractors and materialmen who furnish labor and/or materials;

(ii) written releases (in recordable form) acceptable to Owner from any party that furnished labor, materials or equipment in connection with the Work and who filed liens against the property;

(iii) all required guarantees and certifications in accordance with the terms and conditions of this Contract and the CMT Program;

(iv) any other affidavit, release, waiver notice, certificate or document that may be required by any governmental authority to permit the full use, occupancy and enjoyment of the demised premises and the improvements constructed by Contractor; and

(v) as-built documents in compliance with the requirements of EXHIBIT C.

All above items required in connection with Final Completion shall be completed and submitted no later than thirty (30) days after the opening of the Project by Owner for business to the public and Contractor's submission of all such items to the Owner is a condition precedent to Owner's obligation to make final payment to the Contractor.

(g) All Applications for Payment received and approved by Owner will be paid within fifteen (15) calendar days after receipt by Owner. Owner shall in its sole discretion, have

the right and option to make any and all payments by checks payable to Contractor and subcontractors and material suppliers jointly.

(h) If a Legal Requirement requires Owner to withhold certain monies from Contractor for tax purposes, Owner is hereby authorized by Contractor to withhold such payments from each progress payment and forward the same to the proper authority as required by law.

(i) Contractor shall pay all subcontractors and materialmen in a timely manner so that no claims for mechanic's or materialmen's liens will be filed against the Project. In the event any claim, lien or encumbrance is made or filed as a result of Work for which the Contractor has been paid, Contractor shall cause the same to be discharged by deposit, bonding, payment or otherwise, within thirty (30) days after written request by Owner. If Contractor shall fail to cause such claim, lien or encumbrance to be discharged or insured over within the period aforesaid, then, in addition to any other right or remedy which Owner may have, Owner may, but shall not be obliged to, discharge said claim, lien or encumbrance either by directly paying the amount claimed to be due to the party making the claim, lien or encumbrance or by procuring the discharge of such claim, lien or encumbrance by deposit or by bonding proceeding. Any amount so paid by Owner and all reasonable costs and expenses, including, but not limited to, attorneys' fees, incurred by Owner in connection therewith, shall, at Owner's sole option, (i) be paid by Contractor to Owner on demand or (ii) be set-off by Owner against any retainage or other amounts due or to become due to Contractor.

To the fullest extent permitted by law, Contractor shall indemnify, defend and hold harmless the Owner Group and defend each of them from and against any and all liabilities, losses, damages, penalties, claims, actions, suits, judgments, costs, expenses and disbursements (including reasonable attorney's fees and expenses and reasonable third party costs of investigation) arising out of any and all claims for payment, whether or not reduced to a lien or mechanic's lien, filed by any subcontractors or materialmen, provided such claims, liens or encumbrances are not caused by any default of Owner in paying an undisputed amount due under this Contract.

Contractor shall have the right to contest any such lien, provided it first provides to Owner a bond or other assurances of payment reasonably satisfactory to Owner in the amount of such lien and in form and substance reasonably satisfactory to Owner.

(j) Contractor must meet with Owner within fourteen (14) days after Substantial Completion of the Work to agree on a formal list of construction deficiencies (called the "Punch List"). Contractor further agrees that all Punch List items will be corrected within thirty (30) calendar days after the establishment of the Punch List. If these deficiencies are not corrected within thirty (30) calendar days, Owner may hire an independent contractor to do the Work, and Owner may deduct its costs from the monies retained from Contractor, and/or Owner may bill Contractor for these costs or any shortages in the event the amount withheld is insufficient to complete the Work. Contractor agrees to pay all costs billed by Owner. If an item cannot be corrected within thirty (30) calendar days, the reasons

therefore shall be explained, in writing, to Owner's satisfaction. It is agreed that the preparation of a Punch List by the parties shall in no way waive or alter any other rights of Owner under the contract, including warranties or latent defects.

(k) Notwithstanding any terms of this Contract to the contrary, if Contractor fails to comply with any of the requirements set forth above for the final progress payment, Owner may, at its election, retain the remainder of the Contract Sum or an amount sufficient to protect Owner's interests, including but not limited to, any potential or actual outstanding mechanic's or materialmen's lien rights until all requirements for the final progress payment have been satisfied. If all requirements for the final progress payment have been satisfied, Owner shall release the retainage withheld, less the amount Owner may withhold for setoffs or adjustments under the Contract. In addition, Owner may withhold payments otherwise due hereunder to such extent as may be necessary in Owner's good faith business judgment to protect Owner from loss because of:

- (i) Defective Work not remedied;
- (ii) Contractor's breach of any terms or conditions of this Contract;
- (iii) Third party claims relating to Contractor's performance of the Work filed or reasonable evidence indicating the probable filing of such claims, including, but not limited to mechanic's lien claims;
- (iv) Failure of Contractor to make proper payments to contractors or subcontractors or for labor, materials, supplies or equipment;
- (v) Evidence satisfactory to Owner that the Work cannot be completed for the unpaid balance of the Contract Sum;
- (vi) Damage to Owner's property or that of a third party;
- (vii) Evidence satisfactory to Owner that the Work will not be completed within the Contract Time;
- (viii) Failure of Contractor to carry out the Work in accordance with this Contract.

When the above grounds for withholding payment are removed to Owner's satisfaction, payment shall be promptly made for amounts withheld by reason thereof. If the Contractor fails to perform its obligations under the Contract and becomes obligated to pay Owner a sum of money which exceeds the amount of money retained by Owner under the terms of this Contract, then notwithstanding any terms contained in this Contract to the contrary, in addition to all remedies available at law or in equity, Owner may, at its option, withhold or deduct the amount of money due from the Contractor under this Contract from the monies Owner may be obligated to pay to the Contractor under any other contract between Owner and Contractor.

(l) Any undisputed payment not made by Owner within thirty (30) days of the date when due shall bear interest at the rate of 6% per annum.

8. INDEPENDENT CONTRACTOR / SAFETY / CLEANUP.

(a) Contractor is an independent contractor for the performance of all Work undertaken under this Contract and for the accomplishment of the desired result and Owner shall have no control over the method and means of completing the Work, except that the Contractor shall observe all safety rules and regulations established by Owner, shall exercise due care and diligence to protect the Work and to prevent any injury to or death of any person or damage to property. The Contractor shall at all times enforce strict discipline and good order among its employees, and shall not employ on the job any unfit person or anyone not skilled in the work assigned to him.

(b) The Contractor shall execute and deliver to Owner forms provided by Owner covering the Contractor's Health and Safety Regulations applicable to business operations, the terms and provisions of which are incorporated herein by reference.

(c) The Contractor shall at all times keep the premises free from accumulation of waste materials caused by its operation. Final clean up shall include cleaning of all glass surfaces. The Contractor shall leave the Work "mopped clean" including pressure washing all exterior site surfaces. Cost for this clean up shall be included in the Contract Sum. If the Contractor fails to clean up, the Owner may do so and at Owner's sole option, (i) Contractor shall pay the costs of such clean up to Owner upon demand or (ii) Owner may set-off the costs of such clean up against any retainage or other amounts due or to become due to Contractor.

9. SUBCONTRACTORS.

(a) Nothing contained in this Contract shall create any contractual relation between any subcontractor and the Owner unless Owner accepts assignment of any such subcontract in writing as provided in this Contract. There shall be no obligation on the part of Owner to pay any sums due any subcontractor unless Owner accepts assignment of any such subcontract in writing as provided in this Contract.

(b) Contractor shall pay each subcontractor, upon receipt of payment from Owner, an amount equal to the percentage of completion allowed to the Contractor on account of each subcontractor's work.

(c) Contractor agrees that it is as fully responsible to the Owner for the acts and omissions of its subcontractors and of persons either directly or indirectly employed by them as it is for the acts and omissions of persons directly employed by it.

(d) Contractor will require each subcontractor or supplier, to the extent of the Work to be performed by such subcontractor or supplier to (A) be bound to the Contractor by the

terms of this Contract, (B) assume toward the Contractor all the obligations and responsibilities that the Contractor assumes toward Owner, and (C) designate Owner as the third party beneficiary of any subcontract.

(e) All subcontracts and purchase orders shall include governing law and dispute resolution provisions substantially similar to those included in the Contract such that all subcontractors and suppliers may be joined into any dispute between Owner and Contractor as necessary.

(f) All subcontracts and purchase orders shall provide that they are freely assignable by Contractor to Owner and Owner's assigns. It is further agreed and understood that such assignment is part of the consideration to Owner for entering into this Contract with Contractor and may not be withdrawn prior to Final Completion.

Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that:

(1) assignment is effective only after termination of the Contract by the Owner pursuant to Section 16 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and

(2) assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

Upon assignment to the Owner under this Section, the Owner may further assign the subcontract to a successor contractor or other entity.

10. USE OF PREMISES.

The Contractor shall confine its apparatus, storage of materials, and the operation of its workmen to the limits indicated by the Legal Requirements or direction of Owner and shall not unreasonably permit or allow materials or equipment to accumulate on the premises. The Contractor shall not use any area other than the Project site for storage of materials or apparatus, or the operation of its workmen without the express written permission of the owner of such area. The Contractor shall not use any utilities metered anywhere other than the Project site for any activities related to the Project without the express written permission of the person or entity responsible for the payment of such utilities. If the Contractor uses any area other than the Project site or utilities metered anywhere other than the Project site for activities related to the Project, then the Contractor shall be solely responsible for all resulting losses, damages, demands, claims, suits and other liabilities and shall indemnify, defend and hold harmless Owner Group from all such losses, damages, demands, claims, suits and other liabilities, including reasonable attorney's fees and other expenses of litigation.

After materials and equipment are no longer required for the Work, it shall be promptly removed from the Project site. Protection of materials and equipment stored on the Project site

from weather, theft, damage or other casualty is the sole responsibility of Contractor, including, without limitation the responsibility for deductibles associated with risk coverages for losses due to Contractor's failure to maintain such protection. Owner shall have the right to remove and place in storage materials and equipment unused for two weeks or more at Contractor's expense. The Contractor shall permit and facilitate the inspection of the Work by Owner at any time and it is agreed that Owner may from time to time furnish additional instruction or drawings necessary for the proper execution of the Work.

11. COMPLIANCE WITH LAWS.

The Work shall be in accordance with the best practice of high quality, first class contractors, in compliance with the Plans and Specifications and all applicable codes, rules, regulations, ordinances, laws and statutes of local, County, State and Federal authorities, and lawful orders of any public authority, including without limitation, the Federal Social Security Act, the State and Federal Unemployment Insurance Acts, the state workmen's compensation laws, the Wage and Hour Laws, and applicable tax and license laws and regulations of every kind and description, the Occupational Safety and Health Act, including, but not limited to, the Americans with Disabilities Act ("ADA") and Americans with Disabilities Act Guidelines ("ADAAG"), collectively ("Legal Requirements") and without use of asbestos, asbestos-containing materials, or other hazardous materials as defined from time to time by Legal Requirements. Contractor shall be responsible for becoming familiar with these Legal Requirements (by consulting such professionals as Contractor deems necessary or appropriate), including any changes thereof, and any associated costs are Contractor's responsibility. Contractor assumes exclusive liability for the reporting and payment of any on all contributions, fees and taxes required under any Legal Requirements, and to the fullest extent allowed by law shall indemnify, defend and hold Owner harmless for any damages or penalties Owner may incur as a result of the failure of the Contractor to comply with such Legal Requirements.

If Contractor knows or should know that the drawings and specifications are at variance with each other or any Legal Requirement, including without limitation any ADA or ADAAG violation or any state or local accessibility requirement that may supersede ADAAG, Contractor shall notify Agent in writing before Work is performed. The adjustment of the Contract Sum due to necessary changes shall be adjusted before proceeding with the Work. If any of the Work is done contrary to any Legal Requirements without such notice, Contractor shall bear all costs required to correct such Work.

12. CHANGES IN THE WORK.

Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order or Construction Change Directive. A Change Order shall be based upon agreement among the Owner and Contractor. A Construction Change Directive requires only the signature of the Owner and may or may not be agreed to by the Contractor. A Change Order or Construction Change Directive may be executed through DocuSign electronic signature software, which shall be deemed original signatures and which the parties acknowledge shall be binding and effective. The Contractor shall proceed promptly with

changes in the Work, unless otherwise provided in the Change Order or Construction Change Directive.

All such changes shall be initially authorized by a Field Work Order issued by Owner's representative in the field. The Contractor shall do no Work not expressly provided for under this Contract unless and until he receives a signed Field Work Order authorizing such Work. Subsequently, a Change Order or Construction Change Directive, if the Parties are not able to agree upon the adjustment, if any, in the Contract Sum or Contract Time, shall be submitted and executed in duplicate by the Contractor on a Form approved by Owner, and shall be accompanied by a copy of the Field Work Order authorizing that Work. All Change Orders and Construction Change Directives will be paid by Owner upon Final Completion of the Work and receipt of an Application for Payment from the Contractor.

A Construction Change Directive is a written order signed by the Owner, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- a) Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- b) Unit prices stated in the Contract Documents or subsequently agreed upon; or
- c) As provided below.

If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Owner shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Contract, or if no such amount is set forth in the Contract, a reasonable amount, as determined by the Owner in its reasonable discretion. In such case, the Contractor shall keep and present, in such form as the Owner may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section shall be limited to the following:

- a) Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Owner;
- b) Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- c) Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- d) Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- e) Costs of supervision and field office personnel directly attributable to the change.

If the Contractor disagrees with the adjustment in the Contract Sum or Contract Time set forth in a Construction Change Directive, the Contractor may make a Claim in accordance with the Contract.

A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

Acceptance by the Contractor of a fully executed Change Order shall constitute the Contractor's and the Owner's acceptance of the adjustment to the Contract Sum and Contract Time, if any, set forth in the Change Order as the sole and exclusive recovery by or relief of the Contractor resulting from the change(s) set forth in the Change Order, including any impact or consequential items arising from the change(s). By acceptance of a Change Order, the parties each agree that no further claim will be made by either party as a result of such change(s) and in no event shall the Contractor be entitled to any adjustment to the Contract Sum or Contract Time, damages or other pecuniary compensation other than as set forth in the Change Order, and each party waives and releases the other from any further claims arising in connection with the change(s) and for any direct, indirect, or cumulative delay or impact resulting from the change(s).

In no event shall the Contractor be entitled to receive any compensation for extra work whether partially or fully completed or simply proposed, unless such additional work is authorized by a written Change Order or Construction Change Directive signed by the Owner or the express provisions of the Contract Documents. Only the Owner shall have the right to issue a written Change Order or Construction Change Directive to Contractor authorizing an addition, deletion or other revision in the scope of the Work and/or an adjustment to the Contract Time. The Contractor agrees that the Owner shall not be obligated to pay for any additional work unless the Contractor (1) is authorized in a written Change Order or Construction Change Directive signed by the Owner, or (2) is entitled to compensation for such additional work under the express provisions in the Contract Documents.

13. INDEMNIFICATION.

To the fullest extent allowed by law, the Contractor agrees to protect, indemnify, hold harmless and defend Owner and its parent, subsidiaries and related companies, and the officers, directors, employees, workmen, servants and invitees (the "Owner Group"), from and against all losses, damages, demands, claims, suits and other liabilities, including reasonable attorney's fees and other expenses of litigation, because of (i) bodily injury, including death at any time resulting therefrom, and property damage, including loss of use thereof and downtime, directly or indirectly arising out of or relating to the performance or non-performance of the Work by the Contractor and its subcontractors, and their respective employees, workmen, agents, servants, subcontractors and vendors (the "Contractor Group") or the Contractor Group being present on Owner's premises, excepting only bodily injury or property damage caused by the negligence or willful misconduct of Owner; (ii) the Contractor Group's violation of or failure to comply with any applicable law, regulation, rule or order; and (iii) the Contractor Group's infringement of patent, trade secret or proprietary rights of any third party by any device, process or material, unless the same was

specified by Owner. The Contractor's agreement to protect, indemnify, hold harmless and defend as set forth in the immediately preceding sentence shall not be negated or reduced by virtue of the Contractor's insurance carrier's denial of insurance coverage for the occurrence or event which is the subject matter of the claim and/or refusal to defend the Contractor Group or Owner Group.

In claims against any person or entity indemnified under this Section by an employee of the Contractor, a subcontractor, or supplier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor, a subcontractor, or supplier under workers' compensation acts, disability benefit acts or other employee benefit acts.

14. INSURANCE.

Without limiting, negating or reducing the Contractor's undertaking to protect, indemnify, hold harmless, reimburse and defend Owner and other parties as provided in Section 13 hereof, and as part of the consideration for sums paid the Contractor by Owner hereunder, the Contractor shall at its own cost and expense procure and keep in force and effect the insurance listed below with insurance carrier(s) with a Best Insurance Reports rating of "A" or better and a financial size category of "VIII" or higher and otherwise acceptable to Owner. Before commencing any Work, the Contractor shall furnish Owner with Certificates of Insurance on Owner's forms (or a form otherwise acceptable to Owner) attested by a duly authorized representative of the insurance carrier(s) evidencing that the insurance required hereunder is in force and effect, that such insurance names Owner and any other party specified by Owner, as an additional insured as its interest may appear with a waiver of subrogation, and that the insurance will not expire or be canceled or materially changed without giving to Owner at least thirty (30) days prior written notice (by endorsement if required). In the event the Contractor fails to furnish Owner with acceptable certificates of insurance before the time named in this Contract for commencing Work, Owner shall have the right, but not the obligation, to terminate this Contract.

(a) **Worker's Compensation and Employer's Liability Insurance.** Contractor and all subcontractors retained by or through the Contractor, and all their employees, workmen, agents, and servants shall comply with all requirements of the worker's or workmen's compensations laws of the state or states or other governmental authority in which the Contractor or any subcontractor retained by or through the Contractor is performing any Work hereunder. In addition, the Contractor shall carry Employer's Liability Insurance covering all operations and Work hereunder in an amount not less than \$500,000 per occurrence. All such Worker's Compensation and Employer's Liability Insurance shall expressly provide that all rights of subrogation against Owner are waived.

(b) **General Liability Insurance and Automobile Insurance** (occurrence form): (1) Commercial General Liability Insurance, including Blanket Contractual Liability, Products and Completed Operations Liability and Broad Form Property Damage, covering all Work hereunder, with limits of not less than \$1,000,000 for all liability arising out of injury to or death of one or more persons, in any occurrence/\$2,000,000 aggregate, and \$1,000,000 for all liability arising out of damage to or destruction of property, including loss of use thereof

and downtime, in any one occurrence; (2) Automobile Liability Insurance on all motor vehicles owned, hired, or non-owned, which may be used or connected with any of the Work hereunder, with limits of not less than \$1,000,000 for all liability arising out of damage to or destruction of property, including loss of use thereof and downtime, in any one occurrence/\$2,000,000 aggregate. The policy or policies providing for such insurance shall be endorsed to specifically include the liability assumed by the Contractor under this Contract in Section 13 above in the amounts shown in this Section 14. In addition, such insurance shall specifically name Owner as an additional insured party and shall be primary to any and all other insurance of Owner with respect to any and all claims and demands which may be made against Owner for bodily injury or death resulting therefrom, including injury to or death to the Contractor and its employees, workmen, agents and servants and for property damage, including damage to the Contractor's property, caused by, or alleged to have been caused by, any act, omission or default, negligent or otherwise, of Owner by reason of operations or work hereunder. Such insurance shall specifically provide that it applies separately to each insured against which claim is made or suit is brought, except with respect to the limits of the insurer's liability, and that rights of subrogation against Owner are waived.

(c) Contractor shall maintain a Completed Value Form, All-Risk, Builder's Risk Insurance Policy, that shall insure all Real Property. "Real Property" is defined as the building structure or any part of the build, structure, materials or Owner's equipment that has been received on the site pursuant to this Contract, including, but not limited to foundations, walls, roofs, all building mechanical equipment, building attachments, fixtures and machinery belonging to and constituting a permanent part thereof.

(d) Neither the Owner, its agents nor their respective employees will be responsible for any loss or damage caused to the equipment or materials of the Contractor or to any property or articles belonging to the Contractor or its employees or subcontractors, and Contractor waives subrogation against Owner, its agents and their employees.

(e) The above insurance requirements are minimum requirements and shall not limit the Contractor's liability to Owner in any manner.

(f) In addition to the above, the Contractor will also satisfy any insurance requirements required by any governmental authority.

(g) Without limiting the respective obligations of Contractor and its insurer(s) for the performance or nonperformance of each and every subcontractor and supplier participating in the Work, Contractor will cause all subcontractors performing any portion of the Work to comply in each and every respect with the insuring obligations applicable to Contractor under this Article 14 (other than subsection (c)), including providing to Owner properly prepared certificates of insurance, and copies of additional insured and waiver of subrogation endorsements, before commencing any Work, and again prior to the expiration of any required insurance coverage.

15. SURETY BONDS.

Unless specifically waived by Owner, the Contractor shall furnish surety bonds in the amount of the Contract Sum by a company acceptable to Owner covering the faithful performance of all the Contractor's obligations hereunder, including, but not limited to, payment of all sums which become due hereunder, and which satisfies such bond or performance guaranty requirements as may be imposed by a governmental authority for the faithful performance of the Contract and satisfaction of all conditions, requirements, laws and regulations imposed by governmental authority, including any legal fees, interest, increased costs and expenses Owner may incur to enforce or complete the Contract, in accordance with the Plans and Specifications, and it will provide that the Work at all times be free and clear of all liens of workmen, material suppliers, subcontractors, or due to any activity of Contractor. The bond shall name Owner as obligee and the Contractor shall not begin the Work until such bond is furnished to Owner.

16. TERMINATION FOR CAUSE.

Notwithstanding anything herein to the contrary, if

- (a) relief has been ordered under the Bankruptcy Code with respect to the Contractor, or if the Contractor should make a general assignment for the benefit of its creditors, or if a trustee, receiver, custodian or similar officer should be appointed on account of its insolvency, or
- (b) the Contractor fails, neglects or refuses to perform any or all Work, or
- (c) if a lien has been placed upon or against the Work or the real property upon which the Work is situated, or
- (d) the Contractor fails to make payment to any subcontractor or supplier in accordance with the respective agreements between the Contractor and such subcontractor or supplier, or
- (e) the Contractor disregards any Legal Requirements, or
- (f) the Contractor assigns any monies due or to become due hereunder without the previous written consent of Owner, or
- (g) if at any time Owner believes, in its discretion, that the Work is unreasonably delayed for any reason or any of the provisions of this Contract are being willfully violated or executed carelessly, or that the Contractor is acting in bad faith; or
- (h) if the Work is partially or totally delayed by any labor dispute between the Contractor and its employees or between the Contractor and its employees and any other contractor or subcontractor and their respective employees or any work stoppage or slowdown by the Contractor's employees or any subcontractor or its employees for a period of ten (10) calendar days, or

- (i) the Contractor otherwise materially breaches a provision of the Contract Documents;

then Owner may notify the Contractor in writing and request that it immediately remedy the deficiency or delay. If the Contractor has not remedied or commenced action which promptly will remedy the same within forty-eight (48) hours of notice being delivered, then Owner may without prejudice to any other right or remedy terminate the employment of the Contractor and take possession of the premises and of all materials, tools and appliances thereon and finish the Work by whatever method Owner may deem expedient, including, but not limited to, by accepting assignment of one or more subcontracts pursuant to Section 9. In such case, the Contractor shall not be entitled to receive any further payments until the Work is finished and releases or waivers of all liens have been obtained or the applicable statutory time for filing a lien has passed. If the unpaid balance of the Contract Sum shall exceed the expenses of finishing the Work, including compensation for additional managerial and administrative services, such excess shall be paid to the Contractor. If such expenses shall exceed such unpaid balances, the Contractor shall pay the difference to Owner within ten (10) days of written demand.

17. TERMINATION FOR CONVENIENCE.

Notwithstanding anything herein to the contrary for its convenience, Owner may, without prejudice to any other right or remedy, terminate the engagement of the Contractor in whole or in part at any time by written notice or telephonic notice (confirmed in writing) to the Contractor which notice shall state the extent and effective date of the termination. Upon the giving of such notice, Owner may take possession of the premises and of all materials, tools, and appliances thereon belonging to Owner and finish the Work by whatever method Owner may deem expedient. On the effective date thereof, the Contractor shall (a) stop all Work and place no further orders or subcontracts, (b) terminate work orders and subcontractors outstanding, and (c) take any necessary action to protect property in the Contractor's possession in which Owner has or may acquire an interest. In the event of a termination under this Section, Owner shall pay the Contractor for any and all labor, materials and supervision performed to date of termination, but shall not pay any other costs or expenses on Work not performed.

18. SUSPENSION.

- (a) Notwithstanding anything herein to the contrary and for causes including, but not limited to, those set forth in Section 16 above or for Owner's convenience, Owner may suspend labor, supervision and/or materials furnished by the Contractor hereunder in whole or in part at any time by written notice or telephonic notice (confirmed in writing) to the Contractor stating the extent and effective date of such suspension whereupon the Contractor shall suspend the Work to the extent specified. If the suspension is for causes including, but not limited to, the existence of a condition described in Section 16 hereof, such suspension shall continue until such cause or condition ceases to exist or Owner notifies the Contractor to resume performance under this Contract or Owner terminates this Contract in accordance with Section 17 hereof, whichever is the earliest to occur.

(b) During the period of suspension, the Contractor shall protect and care for all labor, materials and equipment on hand. The Contract Sum and Contract Time shall be adjusted for reasonable increases in the time and reasonable costs actually expended and caused by any such suspension. Owner shall not pay any other costs or expenses on Work not performed. No adjustment shall be made to the extent that:

- (1) performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- (2) an adjustment is made or denied under another provision of the Contract.

19. COOPERATION WITH OTHER CONTRACTORS AND OWNER.

Owner reserves the right to let other contracts in connection with the Work or work related thereto and it is agreed that the Contractor shall cooperate with all other contractors and shall properly coordinate the Work with theirs. The Contractor shall cooperate fully with Owner in performing the Work and shall not interfere with Owner's operations.

20. FORCE MAJEURE AND DELAY.

If the Contractor's completion of the Work on the critical path of the Project is delayed at any time due to fire, flood, epidemic, abnormal weather conditions, acts of God, or other cause not the fault of and beyond control of Owner and Contractor, then the Contract Time shall be extended for such reasonable time as Owner may determine in its reasonable discretion. Claims for extension of time shall be made in writing at the time the delay first occurs, and in any event no later than seven (7) days after the delay occurs. The Owner shall not be held responsible for loss or damage sustained by the Contractor through delay caused by any other contractor or any other cause beyond the control of the Owner. It is expressly understood and agreed that Contractor's sole remedy for any such delay shall be an increase in the Contract Time, without adjustment to the Contract Sum.

If the Contractor's completion of the Work on the critical path of the Project is delayed at any time due to an act, omission, or negligence of Owner, or any other contractor employed by Owner or by changes in the Work, then the Contract Time shall be extended for such reasonable time as Owner may determine in its reasonable discretion and the Contract Sum shall be adjusted for Contractor's actual costs directly resulting from such delay as Owner may determine in its reasonable discretion. Claims for extension of time or adjustment to the Contract Sum shall be made in writing at the time the delay first occurs, and in any event no later than seven (7) days after the delay occurs and shall be subject to Section 22.

Contractor recognizes that this Contract is being entered into during the COVID-19 pandemic (the "Pandemic"). Notwithstanding anything to the contrary in this Contract or the Contract Documents, Contractor verifies that the Contract Sum incorporates governing performance of the Work as established by Pandemic Regulations and that the Contract Time factors in foreseen or reasonably anticipated disruptions in the Work that may be caused by or related to the Pandemic to the supply of labor and materials known or which should have been reasonably anticipated as of the date of the Contract or due to Pandemic Regulations. Contractor will only be entitled to an increase in the Contract Time for Pandemic-related delays for Pandemic

Regulations enacted after the date of the Contract and, with regard to material supply, any unknown delays that could not have been reasonably anticipated as of the date of the Contract. Contractor must use best efforts to mitigate any such disruptions, as consistent with the law, including, but not limited to seeking exemptions from mandated work stoppages. In addition, Contractor recognizes that various governmental authorities have regulations and required guidances with respect to Work performed to the extent imposed as of the date of the Contract ("Pandemic Regulations"). Contractor agrees to comply with all Pandemic Regulations with respect to the Work, as well as subsequently imposed regulations and applicable required guidances issued by governmental authorities and, as may be agreed by Contractor not to be unreasonably withheld or delayed, any additional Owner requirements related thereto. Contractor and the Subcontractors shall be responsible for ensuring that all their respective personnel performing the Work comply with all Pandemic Regulations at the Project site. By way of example, for illustrative purposes only, the Contract Time would be subject to adjustment for Pandemic related quarantines or for a change in the required distance between workers from that required at the time of execution of the Contract, but would not be subject to adjustment of the Contract Time due to compliance with required distances between workers pursuant to the Pandemic Regulations.

21. OWNER'S RIGHT TO ACCELERATE THE WORK.

In the event the Owner determines that the performance of the Work has not progressed or reached a level of completion required by the Contract Documents (and provided such delay is not due to an act, omission, or negligence of Owner, or any other contractor employed by Owner or by changes in the Work), then the Owner may, but is not required to, give the Contractor notice thereof. If, upon such notice, Contractor does not then demonstrate to the Owner's reasonable satisfaction that the Contractor will achieve Substantial Completion within the Contract Time, then the Owner shall have the right to order the Contractor to take recovery measures necessary (at Contractor's sole cost and expense) to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, supervisory and administrative forces, equipment and facilities, (3) paying expediting charges of any subcontractor or material supplier, and (4) taking other similar measures to accelerate the Work. In connection with such recovery measures, Contractor shall provide Owner with a recovery schedule illustrating the required schedule improvement. Such recovery measures shall continue until the progress of the Work complies with the stage of completion required by the Contract. The Owner's right to require recovery measures is for the purpose of ensuring that the Contractor will achieve Substantial Completion within the Contract Time. If Contractor fails to implement such recovery measures as required herein, Owner shall have the right, in addition to all other rights and remedies, to order subcontractors, on Contractor's behalf and at Contractor's sole cost and expense, to effectuate such recovery measures. The Contractor shall not be entitled to an adjustment in the Contract Sum in connection with recovery measures required by the Owner under or pursuant to this paragraph. The Owner may exercise the rights furnished to the Owner under or pursuant to this paragraph as frequently as the Owner deems necessary to ensure that the Contractor will achieve Substantial Completion within the Contract Time. At all times, the Contractor shall cause the Work on the Project to be performed in accordance with the most recent Owner-approved revisions and modifications to its Work under the Contract Documents.

If the Owner directs the Contractor in writing to accelerate its Work due to delays due to an act, omission, or negligence of Owner, or any other contractor employed by Owner or by changes in the Work, and the Contractor agrees (which agreement shall not be unreasonably withheld) that through a plan of acceleration the Contractor can achieve Substantial Completion within the Contract Time (or such other completion dates selected by Owner), Contractor shall be entitled to an increase in the Contract Sum, as appropriate, sufficient to pay the actual premium portion of overtime wages necessary to make up lost time which would otherwise prevent the achievement of Substantial Completion within the Contract Time, but only to the extent of the following conditions: (1) Contractor demonstrates to the Owner that it is impractical to provide, during non-premium pay rate work periods, additional manpower in the delayed trades or other trades sufficient to recover time lost due to such delay; (2) entitlement to overtime premium shall be limited to those time critical trades approved by Owner, and only to the extent of the amount of time lost due to such delay; and (3) Contractor actually achieves Substantial Completion or Final Completion of the entire Work or section of Work, as the case may be, by the required completion date.

22. CLAIMS.

Except as otherwise stated in the Contract, Claims (as defined below) by the Contractor must be initiated within seven (7) calendar days after occurrence of the event giving rise to such Claim or within seven (7) calendar days after the Contractor first recognizes the condition giving rise to the Claim, whichever is later. Claims must be initiated by written notice to the Owner and clearly referencing itself as a Claim pursuant to this Section to be resolved. Notwithstanding any other provision of this Contract, the failure of the Contractor to provide the Owner with written notice of any Claim (whether for an increase in the Contract Sum, revision to the Contract Time, or any other damages or costs of any kind) within the applicable time frame established by this Section shall mean that the Contractor has waived, released and relinquished such Claim and shall perform all Work required by or in connection with any occurrence or condition giving rise to the Claim without increase in the Contract Sum or extension to the Contract Time. A "Claim" is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. In the event of any Contractor Claim for an extension of the Contract Time, such Claim shall include, among other supporting documentation, an estimate of the probable effect of delay on the progress of the Work, as demonstrated by a critical path analysis.

It is the express intention of the Parties that any Claim by Contractor for a change in the Contract Sum, the Contract Time, or any term of this Contract shall be barred unless there is strict compliance with this Section. No course of conduct or dealing between the Parties, no express or implied acceptance of alterations or additions to the Work, and no Claims that Owner has been unjustly enriched by any alteration or addition to the Work, whether in fact there is any such unjust enrichment or not, shall be the basis of a Claim for additional payment under this Contract, or a Claim for any extension of the Contract Time, or a Claim for an amendment to the Contract.

23. CONFIDENTIALITY.

All documents, reports, disclosures, plans and other information of any nature and description obtained by Contractor from the Owner related to the Project, regardless of whether clearly marked by Owner as confidential (“Confidential Information”), will be strictly confidential and will not be used for the benefit of Contractor or any affiliate, subsidiary or parent organization of Contractor, or disclosed to any third party, either during Contractor's execution of the Work or after completion of the Work or termination of the Contract, except as may be necessary in order to perform Work pursuant to this Contract.

Confidential Information is not to be used for any purpose other than the performance of the Work on the Project and shall not be disseminated to anyone not executing a portion of the Work. The Contractor shall not communicate or disclose at any time to any person or entity any Confidential Information, except (i) with the prior written consent of the Owner, (ii) information that was in the public domain prior to the date of the Contract, (iii) information that becomes part of the public domain not due to any unauthorized act or omission of the Contractor, or (iv) as may be required to perform the Work or by any applicable law. If the Contractor becomes legally compelled to disclose any Confidential Information, Contractor shall provide the Owner with prompt notice so that the Owner may seek a protective order or other appropriate remedy or waive compliance with the provisions of this Section. If the Owner does not obtain such a protective order or other remedy, or if it does not waive compliance with the provisions of this Section, the Contractor will furnish only that portion of such Confidential Information which is legally required to be furnished after 7 days prior written notice to Owner detailing the information that Contractor plans to provide.

If the Consultant discloses Confidential Information to its employees, consultants, or contractors to perform the Services, such employees, consultants, and contractors shall be subject to the restrictions on the disclosure and use of Confidential Information as set forth in this Agreement.

24. ENTIRE AGREEMENT; AMENDMENTS.

This Contract represents the entire and integrated agreement between the parties hereto and supersedes all prior negotiations, representations, or agreements, either written or oral. It is expressly understood and agreed that all additions to, changes in, alterations to, waivers of, and amendments to this Contract must be in writing and signed by both parties, except for a Construction Change Directive, which may be signed by the Owner only. It is agreed that this Contract shall not be deemed amended, altered or modified by the term of any sales order used by the Contractor or invoice or Application for Payment rendered or delivered hereunder and Owner shall not be bound by the terms and provisions of any such sales order, invoice, or Application for Payment.

25. REPRESENTATIONS.

The Contractor represents to and covenants with Owner that the Contractor is duly licensed and qualified to do business in the state or states in which the Work is to be performed.

26. EQUAL EMPLOYMENT OPPORTUNITY.

The Contractor shall execute and deliver to Owner forms provided by Owner covering certain Equal Employment Opportunity Provisions and Certification of Nonsegregated Facilities applicable to the Contractor's business and operations, the terms and provisions of each of which are incorporated herein by reference.

27. RECORDS.

The Contractor shall keep all records required by any law or regulation and all other records requested by Owner. Owner shall have the right at any time, upon reasonable notice, to inspect the Contractor's books and records either in the field or at the Contractor's home office to the extent necessary to verify that the Contractor's labor costs and any other costs or expenses as set forth on the monthly statements have been calculated in accordance with this Contract. The Contractor agrees that such books and records shall be maintained for a period of at least three (3) years from the completion date of the Work

28. NOTICES.

All notices required under this Contract shall be in writing and if to Owner, shall be sufficient in all respects if delivered in person or sent by nationally recognized overnight delivery service with delivery confirmation, registered or certified mail to:

VALVOLINE LLC
100 VALVOLINE WAY
LEXINGTON, KY 40509
ATTN: CONSTRUCTION MANAGER

and if to the Contractor shall be sufficient in all respects if delivered in person or sent by nationally recognized overnight delivery service with delivery confirmation, registered or certified mail to:

29. ASSIGNMENT.

The Contractor shall not assign this Contract or subcontract the Work as a whole without the prior written consent of Owner nor shall the Contractor assign any monies due or to become due hereunder without the previous written consent of Owner. Owner shall have the right to assign all of its rights and to delegate all of its duties and obligations under this Contract at any time during the term of the Contract. Owner shall notify Contractor of the name and address of any assignee. Subject to the provisions of this Section, this Contract is binding upon and shall inure to the benefit of Owner and Contractor and their respective successors and assigns.

30. NON-WAIVER / CUMULATIVE REMEDIES.

No failure or delay on the part of Owner in exercising any right, power or privilege hereunder and no course of dealing between the Contractor and Owner shall operate as a waiver thereof; nor shall any single or partial exercise of any right, power or privilege hereunder preclude any other or further exercise thereof or the exercise of any other right, power or privilege. The rights and remedies herein expressly provided are cumulative and not exclusive of any rights or remedies which Owner would otherwise have. No notice to or demand on the Contractor in any case shall entitle the contractor to any other or further notice or demand in similar or other circumstances or constitute a waiver of the right of Owner to any other or further action in any circumstances without notice or demand.

31. SEVERABILITY OF PROVISIONS.

If any part of this Contract, or the application of any such provision to any person or in any circumstance is held invalid, the application of such part to any other person or in any other circumstance or other jurisdictions, and the remainder of this Contract, shall not be affected thereby and shall remain in full effect.

32. SURVIVAL.

The following provisions of this Contract shall survive the complete performance of the Work, any termination, or expiration of this Contract in accordance with its terms: Section 13 (Indemnification), Section 23 (Confidentiality), Section 24 (Entire Agreement; Amendments), Section 25 (Representations), Section 27 (Records), Section 28 (Notices), Section 29 (Assignment), Section 30 (Non-Waiver; Cumulative Remedies), Section 31 (Severability of Provisions), Section 32 (Survival), Section 33 (Use of Marks and Names), Section 34 (Headings), and Section 36 (Governing Law).

33. USE OF MARKS AND NAMES.

Contractor shall not, without the prior written consent of Valvoline, (i) use the tradename, service marks, trademarks or trade dress of Valvoline or of any of its affiliated companies for any purposes, including but not limited to in any advertising, publicity release or sales representation; (ii) reveal the existence of this Contract or the terms or conditions hereof to any person or entity; and (iii) include Valvoline's name in any list of representative clients without Valvoline's express written consent

34. HEADINGS.

Paragraph and Section headings in this Contract are included herein for convenience of reference only and shall not constitute a part of this Contract for any other purpose.

35. NO DISCRIMINATION.

Contractor agrees that in connection with the performance of its obligations under this Contract, it will not discriminate against any person on the basis of race, gender, age, national origin or any other improper or illegal distinction. Contractor shall fully comply with all Legal Requirements relating to the employment of minorities and women as employees, contractors and vendors.

36. GOVERNING LAW.

This Contract shall be governed and constructed in accordance with the laws of the state where the Project is located.

IN TESTIMONY WHEREOF, witness the signatures of the Parties hereto the day and year first above written.

CONTRACTOR:

By: _____

Title: _____

OWNER:

VALVOLINE LLC

By: _____

Title: _____

EXHIBIT A
PLANS AND SPECIFICATIONS
(SEE ATTACHED)

EXHIBIT B

CONTRACT SUM AND SCHEDULE OF VALUES

(SEE ATTACHED)

EXHIBIT C

AS-BUILT DOCUMENT REQUIREMENTS

Contractor shall provide Owner with:

- a site plan noting all underground utilities and the location of all such underground utilities;
- a co-signed set of plans for use on the Premises;
- if the Work is new construction, a rebuild or if the outside building dimensions or footprint have changed, an updated as-built site plan in duplicate; and
- a binder containing all Project related documents, including, but not limited to, warranties, permits, photos, shop drawings, equipment information, and final inspection reports.

CONTRACTORS WORK ADDENDUM

This Addendum is attached and forms a part of the Construction Contract dated _____, 20__ ("Contract") between _____ ("Contractor") and **Valvoline Instant Oil Change, a business of Valvoline, LLC.** ("Agent"). Contractor and Agent agree as follows:

1. Contractor promises to perform the following work ("Contractor's Work"):

This image shows a full page of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

2. The following described drawings, plans and specifications related to the Contractors Work identified below have been delivered to the Contractor and have been cosigned by the parties on _____ 20____. Receipt of a copy of the specifications is hereby acknowledged and the plot plans, plans and specifications are incorporated into and made a part of this Contract. Revisions to the plans and specifications made subsequent to the execution of this Contract, if any, shall be co-signed by the parties and become a part of this Contract. _____

3. If Agent has retained the services of a Construction Manager for the project. The Construction Managers name and address is as follows:

Contractor's Initials

Agent's Initials

**CONTRACTOR'S
CERTIFICATE OF COMPLIANCE**

Instructions: Contractor shall complete and submit this certification to Valvoline upon completion.

Contractor: _____

Project: Construction site common address of: _____

Store Number: _____

I, _____ (“Contractor’s Representative”), with express authorization of
_____ (“Contractor”), certify as follows:

1. On _____, 20__, Contractor and Valvoline entered into a Construction Contract dated
_____, (collectively referred to as the “Contract”) by and between Valvoline, LLC. through its
Division Valvoline Instant Oil Change as agent (“Agent”), and Contractor.

2. The Contract requires that Contractor certify that all Work was performed in compliance with
the Contract Documents, that to the best of its knowledge, information and belief no Defective Work
exists, and that it has performed all of its duties under the Contract in accordance with all Legal
Requirements.

3. On _____, 20__, construction of the Project was substantially complete in accordance
with the terms of the Contract.

4. I certify that Contractor has reviewed and analyzed all Contract Documents.

5. I certify that Contractor has performed all of its obligations and duties under the Contract in
accordance with the Contract Documents and that to the best of its knowledge, information and
belief no Defective Work exists.

6. I certify that to the best of my knowledge, information and belief that construction of the Project
was performed in conformance with the construction documents, the final working plans and
specifications and that no Defective Work exists.

7. I further certify that to the best of my knowledge information and belief the Project, as constructed,
is not in violation of any Contract Documents.

I represent the above certifications are true and correct to the best of my knowledge, information and
belief.

Contractor: _____

Signed and Sealed this ____ day of
_____, 20__.

Certified and
Signed by: _____

Name: _____

Title: _____

Date: _____

Notary Public

VALVOLINE INSTANT OIL CHANGE
100 Valvoline Way – Lexington, KY 40509
CONTRACT FOR LABOR, SUPERVISION AND MATERIALS

Company
Name:
Address:
City, State, Zip
United States

This Agreement shall be effective for the term beginning: _____, and shall continue for a period of two (2) years (the "Initial Term") unless sooner terminated as provided herein. Thereafter, this Agreement shall automatically renew for successive one (1) year periods (the "Renewal Term") unless either party gives the other party at least ninety (90) days prior written notice of termination prior to the expiration of the Initial Term or any Renewal Term. This Agreement is intended to eliminate the necessity of preparing individual contracts on future occasions that we might wish to arrange with you to furnish labor, materials, and supervision, or any of them, to Valvoline LLC., its subsidiaries and affiliates ("OWNER"). Any purchase order of OWNER, specifications, plans or schedules approved in writing by OWNER and CONTRACTOR shall be considered part of the Agreement.

1. SCOPE OF WORK

Subject to the terms and conditions of this Agreement, CONTRACTOR undertakes to provide OWNER with the work or services described in any purchase orders which may be issued by OWNER and accepted by CONTRACTOR from time to time during the term of this Agreement (the "Work").

2. TERM

Work shall be started and shall be substantially completed on the dates specified in any applicable schedule delivered by OWNER to CONTRACTOR. Notwithstanding anything above to the contrary, unless CONTRACTOR is otherwise advised by OWNER in writing, the term of this Agreement shall be extended until completion of any work or services in progress.

3. COMPENSATION

- (a) It is agreed that any Work to be furnished during the term of this Agreement shall be furnished for the following lump sum amount or at the rates set forth on Exhibit A attached hereto.
- (b) No overtime work or premium rates will be paid or authorized by CONTRACTOR unless OWNER has expressly approved such payment in writing; provided that persons expressly designated in writing by OWNER for such purpose may give oral approval to spot overtime work.
- (c) In the event of time and material work, CONTRACTOR must give thirty (30) days advance written notice if it changes rates. No rate change or cost change will be effective until accepted by OWNER in writing. Such change will not apply to any Work in progress at time of notice without OWNER'S written consent.

4. PAYMENT

- (a) For lump sum work, CONTRACTOR shall have the right to request that the OWNER make partial payments; provided, however, that OWNER shall have the right to withhold up to and including _____% of the amount of any invoice submitted to OWNER by CONTRACTOR for labor, supervision and materials furnished by the CONTRACTOR up to the time of completion and, if applicable, _____% of the total contract price set forth above. Payment of said retainage shall be due upon OWNER'S acceptance of all work.
- (b) Each invoice must, in addition to total charges, show separately on its face the labor costs or equipment costs, as applicable, material costs, and any applicable freight charges and sales and use taxes. For reimbursable work, time sheets, equipment logs, material tickets, or similar supporting documentation must be signed by OWNER'S representative. This substantiation or any other evidence the OWNER may require shall be attached to the invoice. In addition, any applicable markups such as fringe benefits, unemployment taxes, workers compensation insurance, payroll taxes, overhead and profit, etc. must be itemized.
- (c) Subject to Paragraph (b) above, OWNER shall pay CONTRACTOR's invoice in accordance with OWNER's payment terms.

5. CHANGES IN THE WORK

OWNER may require CONTRACTOR to make minor changes in the Work which do not involve extra cost. Otherwise, no changes (except emergency work necessary to protect life or property) shall be made without a written change order which shall include OWNER's agreement to any extra charges.

CONTRACTOR shall permit and facilitate the inspection of the work by OWNER at any time and it is agreed that OWNER's engineer may from time to time furnish additional instructions or drawings necessary for the proper execution of this Work.

6. SURETY BONDS

Unless specifically waived by OWNER in writing, CONTRACTOR at its own expense shall furnish a surety bond in the amount of the contract price in a company acceptable to OWNER covering the faithful performance of all of CONTRACTOR's obligations hereunder, including, but not limited to, payment of all sums which become due hereunder, and CONTRACTOR shall not begin any work required hereunder until such bond is furnished to OWNER.

7. WARRANTY

- (a) CONTRACTOR represents and warrants that it is experienced in the Work to be undertaken on behalf of OWNER and possesses the skills to complete the Work.
- (b) The Work shall be performed in a good and workmanlike manner by qualified, careful and efficient workers in accordance with the Agreement, in strict conformity with the best standard practices and in a manner protective of its employees, the public and the environment. CONTRACTOR further guarantees all Work to be performed against defects resulting from poor workmanship or materials furnished by CONTRACTOR for a period of one (1) year from the date

the Work is completed and accepted by OWNER. In the event any Work proves unsatisfactory within the period specified above, without waiving any other rights or remedies OWNER may have at law, CONTRACTOR covenants and agrees to make good such defects and any damage to other work or material caused by the defects or by the repairing of such defects at CONTRACTOR's expense without cost to OWNER.

8. PERMITS, LICENSES AND FEES

Unless in its notification of work OWNER agrees to the contrary, CONTRACTOR shall secure all permits and licenses necessary for the accomplishment of the WORK to be done hereunder and shall comply with all local laws and regulations and, if anything herein contained is at variance with any law or regulation, then the CONTRACTOR shall notify the OWNER's engineer and receive written instructions before proceeding with the Work.

9. WORK TO BE PERFORMED BY OWNER

- (a) OWNER shall furnish CONTRACTOR with a description and scope of each project where appropriate, furnish drawings, specifications, changes and field engineering. OWNER will have the right, at any time and from time to time, to submit revised drawings and specifications.
- (b) OWNER's obligations hereunder to CONTRACTOR shall be strictly limited to the payment for labor, materials, and supervision actually furnished by CONTRACTOR under the terms of this Agreement.

10. COOPERATION WITH OTHER CONTRACTORS AND OWNER

The OWNER reserves the right to let other contracts in connection with this Work or work related thereto and CONTRACTOR shall cooperate with all other contractors and shall properly coordinate its Work with theirs. CONTRACTOR shall cooperate fully with OWNER in performing the Work to be done hereunder and shall not interfere with OWNER's operations.

11. LIENS

- (a) In consideration of the contract price to be paid CONTRACTOR hereunder, CONTRACTOR hereby waives any claim to a lien against the property of OWNER which it now has or which may hereafter arise out of, or during the performance of, this Agreement. CONTRACTOR shall make reasonable efforts to obtain a similar waiver of lien from any subcontractor, materialmen or others providing work or service hereunder and shall immediately advise OWNER in writing in the event any such persons refuse to furnish a waiver of lien.
- (b) Upon notification by OWNER, or upon CONTRACTOR's independently learning of a lien or threatened lien or right of any kind which has been placed upon or against the Work of the real property upon which the Work is situated, by CONTRACTOR's laborers, materialmen, subcontractors or other creditors, CONTRACTOR shall immediately:
 - (1) Pay and discharge the underlying obligations or alleged obligations of the claimed lien; or
 - (2) (i) provide security sufficient and satisfactory to OWNER, or

- (ii) obtain a waiver of lien from such parties as may be satisfactory to OWNER,

CONTRACTOR's failure to comply with the provision of this Paragraph 11(b) within five (5) days of the date CONTRACTOR learns or should have learned of the claimed liens shall constitute a material default hereunder and shall entitle OWNER to pay and discharge all such liens or alleged liens and deduct all such payments from any amounts due CONTRACTOR hereunder whether or not such liens are valid, and shall further entitle OWNER to such remedies as are provided herein or by law.

- (c) Before making any payment hereunder, OWNER may require that CONTRACTOR furnish a full and complete waiver or release of liens from each subcontractor, materialman, artisan, or mechanic retained by CONTRACTOR waiving or releasing any liens or claims whatever against the Work to be performed herein.

12. TERMINATION

- (a) Notwithstanding anything herein to the contrary and for causes including but not limited to those set forth in Paragraph 19 below or for its convenience, OWNER may without prejudice to any other right or remedy terminate the employment of CONTRACTOR in whole or in part at any time by written or telegraphic notice to CONTRACTOR which notice shall state the extent and effective date of the termination. Upon the giving of such notice OWNER may take possession of the premises and of all materials, tools and appliances thereon belonging to OWNER and finish the Work by whatever method OWNER may deem expedient or elect not to complete the Work. On the effective date thereof, CONTRACTOR shall (a) stop all Work and place no further orders or subcontracts, (b) terminate work orders and subcontractors outstanding, and (c) take any necessary action to protect property in CONTRACTOR's possession in which OWNER has or may acquire an interest. In the event of a termination under this paragraph, OWNER shall pay CONTRACTOR for any and all labor, materials and supervision performed to date of termination.
- (b) Notwithstanding anything herein to the contrary, if relief has been ordered under the Bankruptcy Code with respect to CONTRACTOR, or if CONTRACTOR should make a general assignment for the benefit of its creditors, or if a trustee, receiver, custodian or similar officer should be appointed on account of insolvency, or should CONTRACTOR fail, neglect or refuse to perform any or all Work, or if a lien has been placed upon or against the Work or the real Property upon which the Work is situated and is not discharged or satisfied as provided in Paragraph 11 above, or CONTRACTOR assigns any monies due or to become due hereunder without the previous written consent of OWNER, or at any time OWNER believes, in its discretion, that the work is unreasonably delayed for any reason or any of the provisions of this Agreement are being willfully violated or executed carelessly, or that CONTRACTOR is acting in bad faith, or if the Work is partially or totally delayed by any labor dispute between CONTRACTOR and its employees or between CONTRACTOR and its employees and any other contractor and its employees or any Work stoppage or slowdown by CONTRACTOR's employees for a period of ten (10) calendar

days, then OWNER or its representatives may notify CONTRACTOR in writing and request that it immediately remedy the deficiency or delay; and, if the same shall not be remedied within twenty-four (24) hours of notice being delivered, then OWNER may without prejudice to any other right or remedy terminate the employment of CONTRACTOR and take possession of the premises and of all materials, tools and appliances thereon and finish the Work by whatever method OWNER may deem expedient. In such case, CONTRACTOR shall not be entitled to receive any further payments until the Work is finished and releases or waivers of all liens have been obtained, or the applicable statutory time for filing a lien has passed. If the unpaid balance of the contract price shall exceed the expenses of finishing the Work, including compensation for additional managerial and administrative services, such excess shall be paid to CONTRACTOR. If such expenses shall exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. If it is determined, however, that CONTRACTOR's failure to perform is not due to the breach, fault or negligence of CONTRACTOR (other than insolvency or an act of bankruptcy) such cancellation shall be deemed to have been made pursuant to Paragraph 12(a) hereof.

13. SUSPENSION

- (a) OWNER may suspend the Work in whole or in part at any time by written or telegraphic notice to CONTRACTOR stating the extent and effective date of such suspension whereupon CONTRACTOR shall suspend the Work to the extent specified. If the suspension is for causes including, but not limited to, the existence of a condition described in Paragraph 19 hereof, such suspension shall continue until such cause or condition ceases to exist or OWNER notifies CONTRACTOR to resume performance under this Agreement or OWNER terminates this Agreement in accordance with Paragraph 12 hereof, whichever is the earliest to occur. If suspension is for the convenience of OWNER and such suspension continues for twenty (20) working days, CONTRACTOR shall have the right to terminate this Agreement in whole or in part by written or telegraphic notice to OWNER which notice shall state the extent and effective date of the termination. In such event this Agreement shall terminate in accordance with the provisions of Paragraph 12 hereof.
- (b) During the period of suspension, CONTRACTOR shall protect and care for the Work on hand. If the cost of the Work, including the cost of additional labor, supervision and materials made necessary by the suspension, is increased or decreased by the suspension, CONTRACTOR shall give OWNER a written estimate of the increase or decrease in the cost of the Work resulting from such change. IF OWNER accepts the estimate, OWNER shall issue a written purchase order per Paragraph 5. If OWNER and CONTRACTOR cannot mutually agree on such amount within ten (10) working days from the date of OWNER's notice of disagreement with CONTRACTOR's original estimate, either party shall have the right to terminate this Agreement in whole or in part by notice to the other party which notice, as provided in Paragraph 23 hereof, shall state the extent and effective date of the termination. In such event this Agreement shall terminate in accordance with the provisions of Paragraph 12 hereof.

14. CONFLICTING PROVISIONS

The terms, provisions, covenants, or conditions herein shall control in the event of any conflict with any provision, term, covenant or condition in any of the documents attached hereto and made a part hereof, or any work orders, purchase orders, requisitions, or any other forms or documents.

15. INDEMNIFICATION

CONTRACTOR agrees to protect, indemnify, hold harmless and defend OWNER, its subsidiaries and related companies, and officers, directors, employees, workmen, agents, servants and invitees of OWNER, its subsidiaries and related companies (collectively, "Indemnitees"), from and against all losses, damages, demands, claims, suits and other liabilities (including attorney fees and other expenses of litigation) relating to or arising out of:

- (i) bodily injury, including death (including without limitation injury to or death of an INDEMNITEE or its employees) at any time resulting therefrom,
- (ii) damages to all property (including without limitation, the property of INDEMNITEES), including loss of use thereof and downtime,
- (iii) contamination of or adverse effects on the environment, including the cost of cleanup,
- (iv) violation of or failure to comply with any applicable law, regulation, rule or order which occur, either directly or indirectly, in connection with performance of the Work or by reason of CONTRACTOR and its employees, workers, agents, servants, subcontractors and vendors being present on OWNER's premises, except to the extent the liability, loss or damage is attributable to and caused by the sole and exclusive negligence of OWNER,
- (v) infringement of patent, trade secret or proprietary rights of any third party by any device, process or material not specified by OWNER, and
- (vi) CONTRACTOR'S presence on OWNER'S premises regardless of whether any liability arises out of or relates to the negligence (active or passive) fault, and/or strict liability of an INDEMNITEE occurring jointly, concurrently and/or comparatively with the negligence, fault, and/or strict liability of CONTRACTOR and/or any other person that is not an INDEMNITEE, other than the sole negligence of such INDEMNITEE.

CONTRACTOR'S agreement to protect, indemnify, hold harmless and defend as set forth in the immediately preceding sentence shall not be negated or reduced because CONTRACTOR'S insurance carrier denies insurance coverage for the claim and/or refusal to defend CONTRACTOR or OWNER. In addition, CONTRACTOR will pay all costs and expenses, including attorney fees and all other expenses of litigation incurred by an INDEMNITEE to enforce the foregoing agreement to protect, indemnify, hold harmless and defend an INDEMNITEE.

16. INSURANCE

Without limiting, negating or reducing CONTRACTOR'S undertaking to protect, indemnify, hold harmless, and defend OWNER and other parties as provided herein, and as part of the consideration for any sums paid CONTRACTOR by OWNER hereunder, CONTRACTOR shall at its own cost and expense procure and keep in force and effect the insurance listed below with insurance carrier(s) acceptable to OWNER. Before commencing to provide any Work, CONTRACTOR shall furnish OWNER with Certificates of Insurance attested by a duly authorized representative of the insurance

carrier(s) evidencing that the insurance required hereunder is in force and effect and that such insurance will not be canceled or materially changed without giving to OWNER at least 30 days prior written notice. If CONTRACTOR fails to provide or maintain any or all of the insurance required hereby or otherwise fails to comply with any of the requirements of this Section, and, in spite of such failure, OWNER allows performance of Work to commence or to continue, CONTRACTOR shall not be released from its obligation to supply such insurance or to comply with such requirements, and shall be liable for any and all damages and losses suffered by OWNER as a consequence of such failure.

(a) Worker's Compensation and Employer's Liability Insurance: CONTRACTOR, all subcontractors retained by or through CONTRACTOR, third party, and all their employees, workmen, agents, and servants shall comply with all requirements of the worker's or workmen's compensation laws of the state or states or other governmental authority in which CONTRACTOR, any subcontractor retained by or through CONTRACTOR, or third party is providing any Work hereunder. In addition, CONTRACTOR shall carry Employer's Liability Insurance covering all Work hereunder in an amount not less than \$500,000 per occurrence. All such Worker's Compensation and Employer's Liability Insurance shall expressly provide that all rights of subrogation, where permitted by law, are waived.

(b) General Liability Insurance and Automobile Liability Insurance (occurrence form):

(1) General Liability Insurance, including Blanket Contractual Liability, Products and Completed Operations Liability, XCU Hazards and Broad Form Property Damage, covering all Work hereunder, with limits of not less than the following:

Commercial General Liability - \$5,000,000 Combined Single Limit for all liability arising out of injury to or death of one or more persons, in any one occurrence, and for all liability arising out of damage to or destruction of property, including loss of use thereof and downtime, in any one occurrence, with a General Annual Aggregate not less than \$5,000,000;

(2) Automobile Liability Insurance on all motor vehicles owned, hired, or non-owned which may be used or connected with delivery of any of the Work hereunder, with limits of not less than \$5,000,000 Combined Single Limit for all liability arising out of injury to or death of one or more persons, in any one occurrence, and for all liability arising out of damage to or destruction of property, including loss of use thereof and downtime, in any one occurrence. If the CONTRACTOR or its subcontractors use automobiles to transport hazardous materials they shall have an MCS-90 endorsement ("Environmental Restoration") included in their Automobile Liability Insurance.

(c) Contractor's Pollution Legal Liability/Environmental Impairment Insurance coverage - \$5,000,000 per occurrence with a Annual Aggregate not less than \$5,000,000.

The policy or policies providing for such insurance shall be endorsed to specifically include the liability assumed by CONTRACTOR under this Agreement. In addition, with the exception of Worker's Compensation and Employer's Liability and Contractor's Pollution Legal Liability/Environmental Impairment Insurance, such insurance shall

specifically name OWNER as an additional insured party, and shall be primary to any and all other insurance of OWNER, with respect to any and all claims and demands which may be made against OWNER for bodily injury or death resulting therefrom, including injury to or death of CONTRACTOR and its employees, workmen, agents and servants, and for property damage, including damage to CONTRACTOR 'S property, caused by, or alleged to have been caused by, any act, omission or default, negligent or otherwise, of OWNER by reason of Work delivered hereunder. All such Worker's Compensation and Employer's Liability Insurance shall expressly provide that all rights of subrogation against OWNER are waived. Such insurance shall specifically provide that it applies separately to each insured against which claim is made or suit is brought, except with respect to the limits of the insurer's liability, and that all rights of subrogation against OWNER are waived.

The above insurance requirements are minimum requirements and shall not limit CONTRACTOR 'S liability to Valvoline in any manner.

17. RECORDS

- (a) CONTRACTOR agrees to retain all records and accounts related to charges or CONTRACTOR invoices for a period of at least three (3) years from the completion date of any Work performed.
- (b) CONTRACTOR shall permit OWNER access to, either in the field or at the home office, for review and audit, at all reasonable times, all records and accounts relating to costs and expenses invoiced to OWNER under this Agreement.

18. INDEPENDENT CONTRACTOR

CONTRACTOR is an independent contractor. OWNER shall exercise no control over the method and means of accomplishing the Work other than to see that the desired results are achieved at the lowest possible cost to OWNER.

19. FORCE MAJEURE

Except for the payment of any sums due, neither party shall be responsible for any failure to fulfill any term of this Agreement, if fulfillment has been delayed, hindered or interfered with or prevented by any circumstances whatsoever, which are not within the control of the party in question and could not have been prevented or overcome by the exercise of due diligence by the party concerned.

20. COMPLIANCE WITH LAWS AND REGULATIONS

- (a) CONTRACTOR agrees to comply with the Federal Social Security Act, the state and Federal Unemployment Insurance Acts, the Americans With Disabilities Act, state workers compensation laws, wage and hour laws, any and all applicable sales, use, and gross receipts tax laws and regulations, applicable safety and health laws, standards and regulations, any applicable environmental laws and regulations, and all other applicable laws, regulations, guidelines, permits, licenses and approvals concerning the Work and CONTRACTOR assumes exclusive liability for the reporting and payment of any and all contributions and taxes required thereby.

- (b) CONTRACTOR shall execute OWNER's Exhibit B covering certain Equal Employment Opportunity Provisions and Certification of Non-segregated Facilities.
- (c) CONTRACTOR shall abide by OWNER's safety and health regulations while performing any Work and shall execute Exhibit C, OWNER's Safety and Health Practices.

21. ASSIGNMENTS AND SUBCONTRACTS

CONTRACTOR shall not assign this Agreement or sublet the Work as a whole or part without the prior written consent of OWNER.

22. GOVERNING LAW

This Agreement shall be construed, and the rights of the parties shall be determined, in accordance with the laws of the State of Ohio.

23. NOTICES

All notices required under this Agreement shall be in writing and if to OWNER, shall be sufficient in all respects if delivered in person or sent by registered or certified mail, return receipt requested, or by telex, telecopy or other facsimile to the addresses above or such other addresses as may be designated from time to time.

24. CONFIDENTIALITY

Any technical information, experience or data concerning Company's business, including without limitation its services, plans, programs, plants, processes, products, costs, equipment, operations or customers, which may come within the knowledge of CONTRACTOR, its officers or employees in the performance of this Agreement shall be treated as confidential property of Company and shall not be used by CONTRACTOR except for the benefit of Company in the furtherance of this Agreement, and shall not be disclosed to others, including governmental agencies or other authorities during or subsequent to the term of this Agreement without in each instance securing the prior written consent of Company. Any such information provided by Company to CONTRACTOR in writing or other tangible media shall be returned to Valvoline upon termination of this Agreement.

25. OWNERSHIP OF WORK PRODUCT

CONTRACTOR hereby agrees to transfer to Company the entire right, title and interest to any copyrights in any work produced by CONTRACTOR under this Agreement. CONTRACTOR further agrees to execute any documents which may be necessary or appropriate to allow Company to perfect its interest in the copyright for such works. CONTRACTOR shall not be entitled to any additional payment or compensation for assisting and cooperating with the Company in obtaining these copyrights.

26. DRAWINGS

All drawings and documents prepared by CONTRACTOR in connection with its performance of the Work are the property of OWNER and are not to be used on other projects except by agreement of OWNER in writing. All such drawings and documents shall be transmitted to OWNER at the completion of the work.

27. ENTIRETY OF AGREEMENT

This Agreement is intended by the parties as the final, complete and exclusive statement of the terms, conditions and specifications of their agreement and is intended to supersede all previous agreements and understandings between the parties relating to its subject matter. No prior stipulation, agreement, understanding or course of dealing between the parties or their agents with respect to the subject matter of this Agreement shall be valid or enforceable unless embodied in this Agreement. No amendment, modification, termination notice or waiver of any provision of this Agreement shall be valid or enforceable unless in writing and signed by the party to be charged. This Agreement shall supersede, and shall not be modified or amended in any way by the printed terms of any purchase order, proposal, quotation or other document which may be issued by either party covering work or services rendered.

28. WAIVER

The failure of any party to insist upon strict performance of any of the terms, conditions and provisions of this Agreement shall not be deemed a waiver of future compliance therewith by the party by which the same is required to be performed hereunder and shall in no way prejudice the remaining provisions of this Agreement.

29. BINDING EFFECT

All rights conferred by this Agreement shall be binding upon, inure to the benefit of, and be enforceable by or against the respective successors and assigns of the parties hereto.

30. SEVERABILITY

If any provision of this Agreement, or the application of any such provision to any person or in any circumstance is held invalid, the application of such provision to any other person or in any other circumstance, and the remainder of this Agreement, shall not be affected thereby and shall remain in full effect.

31. DISPUTE RESOLUTION

The parties shall attempt in good faith to resolve any dispute arising out of or relating to this Agreement promptly by negotiation between the management of each party. If the matter has not been resolved within sixty (60) days of a party's request for negotiation, either party may initiate arbitration as provided herein.

Any controversy or claim arising out of or relating to this Agreement, or breach thereof, shall be settled by arbitration administered by the American Arbitration Association under its Commercial Arbitration Rules, and judgment on the award rendered by the arbitrator may be entered in any court having jurisdiction thereof.

Either party may make a demand for binding arbitration by filing with the American Arbitration Association a demand in writing signed by an officer of the complaining party. The parties shall agree upon one arbitrator which will be selected and appointed in accordance with the Commercial Rules of the American Arbitration Association. The arbitration shall take place in Lexington, KY.

32. HEADINGS

The headings in this Agreement are inserted for convenience only and shall not effect the construction hereof.

33. GENERAL

Although this Agreement contemplates notification by OWNER and acceptance thereof by CONTRACTOR, both in writing, before commencement of Work, it is specifically understood and agreed that any Work performed by CONTRACTOR for OWNER hereafter shall be under the terms hereof, unless (and only to the extent that) by specific written agreement other terms inconsistent herewith are agreed upon by the parties hereto with respect to such work.

VALVOLINE INSTANT OIL CHANGE

By: _____

By: _____

Title: _____

Title: _____

Contractor Performance Evaluation

Date of Assessment: _____

Originated by: _____

General Information

1. Name of Company: _____.

Address Line 1: _____

Address Line 2: _____

City, State, Zip: _____

Country: _____

Telephone Number: _____

Fax Number: _____

2. Safety Evaluation Completed By:

Name: _____

Title: _____

Telephone: _____

Fax: _____

Organization Information

3. Describe Services Performed:

- Construction
- Construction Design
- Original Equipment Manufacturer and Installer
- Project Maintenance
- Maintenance

SIC Code:

- Original Equipment Manufacturer and Maintenance
- Service Work (e.g., Janitorial/clerical/etc.)
- Manpower and Resource
- Other

If other, please list: _____

4. Describe Additional Services Performed: _____

5. List other types of work within the services you normally perform that you subcontract to others:

6. List of major equipment (e.g. cranes, JLGs, forklifts) your company has available for work at this facility and the method of establishing competency to operate.

7. Do you normally employ?

- Union Personnel
 - Non-Union Personnel
- If union, list trades/locals:

Safety & Health Performance Section

1. Workers Compensation Experience Modification Rate (EMR) Data

a. EMR is:

- Interstate rate
- Intrastate rate
- Monopolistic State rate
- Dual rate

b. EMR for three last years:

2008 _____ 2007 _____ 2006 _____

c. State of Origin: _____

d. EMR Anniversary Date: _____ (format mm/dd/yyyy)

2. Injury and Illness Data:

a. Employee hours worked last three years (excluding subcontractors)

Hours/Year	2008	2007	2006
Field			
Total			

b. Provide the following data (excluding subcontractor) using your OSHA 300 Forms from the past three (3) years:

	2008		2007		2006	
Rating Category	No.	Rate	No.	Rate	No.	Rate
Work-related fatality. Rate = $\frac{\text{Total Col. G} \times 200,000}{\text{Total Employee Hours}}$						
Lost workday cases involving days away from work, or days of restricted work activity, or both. Rate = $\frac{\text{Total Col. H \& I} \times 200,000}{\text{Total Employee Hours}}$						
Lost workday case cases involving days away from work. Rate = $\frac{\text{Total Col. H} \times 200,000}{\text{Total Employee Hours}}$						
Cases involving medical treatment only. Rate = $\frac{\text{Total Col. J} \times 200,000}{\text{Total Employee Hours}}$						
Total OSHA Recordable Injury Rate. Rate = $\frac{(\text{Total Col. G \& H \& I \& J}) \times 200,000}{\text{Total Employee Hours}}$						

Notes: (1) Data should be the best available data applicable to the work in this region or area.

(2) If your company is not required to maintain OSHA 300 forms, please provide information from your Worker's Compensation insurance carrier itemizing all claims for the last three years.

3. Have you received any regulatory (EPA, OSHA, etc.) citations in the last three years?

Yes No

If Yes, please give details: _____

4. Are there any judgments, claims or suits pending or outstanding against your company? Yes No

If Yes, please give details: _____

5. Are you now or have you ever been involved in any bankruptcy or reorganization proceedings? Yes No

If Yes, please give details: _____

If Yes, please attach copies. _____

Safety & Health Management Section

1. Highest ranking safety/health professional in the company:

Name: _____

Title: _____

Telephone: _____

Fax: _____

2. Do you have or provide:

a. Full time Safety/Health Director -	Yes	No
b. Full time Site Safety/Health Supervisor -	Yes	No
c. Full time Job Safety/Health Coordinator -	Yes	No

3. Do you have or provide:

a. Company paid health insurance -	Yes	No
b. Company paid dental insurance -	Yes	No
c. Paid sick leave -	Yes	No
d. Safety/Health incentive program -	Yes	No
e. Company paid safety/health training -	Yes	No

Safety & Health Program & Procedures Section

1. Do you have a written Safety and Health Program: Yes No

(If No, proceed to question 3)

Does the program address the following key elements?

- Management commitment and expectations	Yes	No
- Employee participation	Yes	No

- Accountabilities and responsibilities for managers, supervisors, and employees	Yes	No
- Resources for meeting safety & health requirements	Yes	No
- Periodic safety and health performance appraisals for all employees	Yes	No
- Hazard recognition and control	Yes	No

2. Does the program include work practices and procedures such as:

a. Equipment Lockout and Tagout (LOTO)	Yes	No
b. Confined Space Entry	Yes	No
c. Injury & Illness Recording	Yes	No
d. Fall Protection	Yes	No
e. Personal Protective Equipment	Yes	No
f. Portable Electrical/Power Tools	Yes	No
g. Vehicle Safety	Yes	No
h. Compressed Gas Cylinders	Yes	No
i. Electrical Equipment Grounding Assurance	Yes	No
j. Powered Industrial Vehicles (Cranes, Forklifts, JLGs, etc)	Yes	No
k. Housekeeping	Yes	No
l. Accident/Incident Reporting	Yes	No
m. Unsafe Condition Reporting	Yes	No
n. Emergency Preparedness, including evacuation plan	Yes	No
o. Waste Disposal	Yes	No

3. Do you have written programs for the following:

a. Hearing Conservation	Yes	No
b. Respiratory Protection	Yes	No
Where applicable, have employees been:		
• Trained		
• Fit tested		
• Medically approved		
c. Hazard Communication	Yes	No
d. Program to support the contractor requirements of the OSHA Process Safety Management of Highly Hazardous Chemicals, Explosives and Blasting Agents Standard (29 CFR 1910).	Yes	No

4. Do you have a substance abuse program?

Yes No

If Yes, does it include the following:

- Pre-employment Testing	Yes	No
- Random Testing	Yes	No
- Testing for Cause	Yes	No
- DOT Testing	Yes	No

5. Do your employees read, write, and understand English such that they can perform their job tasks safely without an interpreter?

Yes No

If No, provide a description of your plan to assure that they can safely perform their jobs. _____

6. Medical**a. Do you conduct medical examinations for:**

- Pre-employment	Yes	No
- Preplacement Job Capability	Yes	No
- Pulmonary	Yes	No
- Respiratory	Yes	No

b. Describe how you will provide first aid and other medical services for your employees while on-site.

Specify who will provide this service: _____

c. Do you have personnel trained to perform first aid and CPR: Yes No
7. Do you hold site safety and health meetings for:

Field Supervisors	Yes	No	If yes, Frequency
Employees	Yes	No	If yes, Frequency
New Hires	Yes	No	If yes, Frequency
Subcontractors	Yes	No	If yes, Frequency

If Yes, are the safety and health meetings documented? Yes No

8. Personal Protection Equipment (PPE)

a. Is applicable PPE provided for employees?	Yes	No
b. Do you have a program to assure that PPE is inspected and maintained?	Yes	No

9. Do you have a corrective action process for addressing individual safety and health performance deficiencies. Yes No
10. Equipment and Materials:

a. Do you have a system for establishing applicable health, safety, and environmental specifications for acquisition of materials and equipment?	Yes	No
b. Do you conduct inspections on operating equipment (e.g., cranes, forklifts, JLGs) in compliance with regulatory requirements?	Yes	No
c. Do you maintain operating equipment in compliance with regulatory requirements?	Yes	No
d. Do you maintain the applicable inspection and maintenance certification records for operating equipment?	Yes	No

11. Subcontractors

a. Do you use safety and health performance criteria in selection of subcontractors?	Yes	No	N/A
b. Do you evaluate the ability of subcontractors to comply with applicable health and safety requirements as part of the selection process?	Yes	No	N/A
c. Do your subcontractors have a written Safety & Health Program?	Yes	No	N/A
d. Do you include your subcontractors in:			
- Safety & Health Orientation	Yes	No	N/A

- Safety & Health Meeting	Yes	No	N/A
- Inspections	Yes	No	N/A
- Audits	Yes	No	N/A
12. Inspections and Audits			
a. Do you conduct safety and health inspections?	Yes	No	N/A
b. Do you conduct safety and health program audits?	Yes	No	N/A
c. Are corrections of deficiencies documented?	Yes	No	N/A

Safety & Health Training Section

1. Craft Training			
a. Have employees been trained in appropriate job skills?	Yes	No	N/A
b. Are employees job skills certified where required by regulatory or industry consensus standards?	Yes	No	N/A
c. List crafts which have been certified: _____			

2. Safety & Health Orientation	New Hires		Supervisors	
a. Do you have a Safety & Health Orientation Program for new hires and newly hired or promoted supervisors?	Yes	No	Yes	No
b. If Yes, does program provide instruction on the following:				
- New Worker Orientation	Yes	No	Yes	No
- Safe Work Practices	Yes	No	Yes	No
- Safety Supervision	Yes	No	Yes	No
- Toolbox Meetings	Yes	No	Yes	No
- Emergency Procedures	Yes	No	Yes	No
- First Aid Procedures	Yes	No	Yes	No
- Incident Investigation	Yes	No	Yes	No
- Fire Protection and Prevention	Yes	No	Yes	No
- Safety Intervention	Yes	No	Yes	No
c. If yes, how long is the orientation program?	Hours			

3. Safety & Health Training		
a. Do you know the regulatory safety and health training requirements for your employees?	Yes	No
b. Have your employees received the required safety and health training and retraining?	Yes	No
c. Do you have a specific safety and health training program for supervisors?	Yes	No

4. Training Records		
a. Do you have safety and health and crafts training records for your employees?	Yes	No
b. If yes, do the training records include the following:		
- Employee identification	Yes	No
- Date of training	Yes	No
- Name of trainer	Yes	No
- Method used to verify understanding	Yes	No
c. How do you verify understanding of training?		

- **Written test**
- **Oral test**
- **Performance test**
- **Job Monitoring**
- **Other (please list below)**

Date

XYZ, Inc
Sample Rd
USA
Attn. John Doe

Re: Valvoline Instant Oil Change

Dear John:

You are invited to submit a proposal to construct our prototype 3-bay Valvoline Instant Oil Change facility referenced above. A disk of bid drawings and specifications along with the geotechnical report are attached for your reference. Drawings have been submitted for permits to the city of USA. It is our intention to select the contractor based on the best overall proposal. The low bid is not necessarily the only criteria.

The building drawings reflect our new prototype design and it is recommend that you and your subcontractors carefully review the documents to avoid making erroneous assumptions based on any past work with VIOC. Your written proposal should be submitted on the enclosed proposal form and returned to my attention postmarked, faxed or e-mailed no later than midnight ????.

The following documents are included for your review:

- Contract to Furnish Labor, Supervision and Materials
- Bid Proposal Form - Exhibit A
- Equal Employment Opportunity Form - Exhibit B
- Owner Safety and Health Regulations - Exhibit C
- Ethical Standards Policy Statement - Exhibit D
- Bid Clarifications and Additions

Please be sure to complete the enclosed bid form completely. The accuracy and completeness of the form is an important aspect of the selection of the successful bidder. An electronic version will be forwarded to you. Any questions or comments regarding any of the enclosed information or the construction bid documents should be directed to

Sincerely,

VIOC Project Manager

SECTION 00100 - INSTRUCTIONS TO BIDDERS**TABLE OF ARTICLES**

1. Defined Terms
2. Bids Received
3. Location and Description of Project
4. Copies of Bidding Documents
5. Qualifications of Bidders
6. Examination of Contract Documents and Site
7. Interpretations and Addenda
8. Bid Security
9. Contract Time
10. Liquidated Damages
11. Substitute Materials and Equipment
12. Subcontractors and Others
13. (Not Used)
14. Preparation of Bid
15. Submission of Bid
16. Modification or Withdrawal of Bid
17. Opening of Bids
18. Disqualification of Bidders
19. Bids to Remain Subject to Acceptance
20. Award of Contract
21. Contract Securities
22. Contractor's Insurance
23. Execution of Agreement
24. Notice to proceed
25. Pre-Bid Conference

ARTICLE 1 - DEFINED TERMS

- 1.1 Terms used in these Instructions to Bidders, which are defined in the General and Supplementary Conditions, have the meanings assigned to them in the General and Supplementary Conditions. The term "Successful Bidder" means the Bidder to whom OWNER (on the basis of OWNER'S evaluation as hereinafter provided) makes an award.

ARTICLE 2 - BIDS RECEIVED**ARTICLE 3 - LOCATION AND DESCRIPTION OF PROJECT**

- 3.1 Refer to cover sheet CS-1 of drawings.

ARTICLE 4 - COPIES OF BIDDING DOCUMENTS

- 4.1 Refer to Notice to Bidders for information on examination and procurement of documents.
- 4.2 Complete sets of Bidding Documents shall be used in preparing Bids. Contractor shall confirm that all specifications and details listed are included in the bid documents provided by the OWNER.
- 4.3 OWNER is making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

ARTICLE 5 - QUALIFICATIONS OF BIDDERS

- 5.1 Bidders shall be experienced in the kind of Work to be performed, shall have the necessary equipment therefore, and shall possess sufficient capital to properly execute the Work within the time allowed. Bids received from Bidders who have previously failed to complete work within the time required, or who have previously performed similar work in an unsatisfactory manner, may be rejected.
- 5.2 As evidence of Bidder's qualifications to perform the Work, Bidder may be required to complete and submit with his Bid, an AIA Bidder's Qualification Statement. Low Bidders may be asked to furnish additional data to demonstrate their qualifications.
- 5.3 The Bid must contain evidence of Bidder's qualification to do business in the State of said work or covenant to obtain such qualification prior to execution of Agreement.

ARTICLE 6 - EXAMINATION OF CONTRACT DOCUMENTS AND SITE

- 6.1 Before submitting a Bid, Bidder shall (a) examine the Contract Documents thoroughly, (b) visit the site to familiarize itself with local conditions that may affect cost, progress, performance or furnishing of the Work, (c) familiarize itself with federal, state and local laws, ordinances, rules and regulations that may affect cost, progress, performance or furnishing of the Work, (d) examine the Contract Documents for other work to be performed on the Project that relates to the Work for which the Bid is to be submitted, with the Contract Documents, and (e) notify OWNER of any conflict, error, ambiguity or discrepancy in the Contract Documents of which Bidder becomes aware.
- 6.2 On request, OWNER will allow a site visit for the Bidder during OWNER'S normal business hours.
- 6.3 The submission of a Bid will constitute an incontrovertible representation by Bidder that it has complied with every requirement of this Article 6 and that the Contract Documents are efficient in scope and detail to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

- 7.1 All questions about the meaning or intent of the Bidding Documents or the Contract Documents shall be submitted to OWNER in writing. In order to receive consideration, questions must be received by OWNER no later than three days prior to the bid due date. The OWNER will not be responsible for oral interpretations or clarifications which anyone presumes to make on their behalf.
- 7.2 OWNER may issue such additional Addenda as may be necessary to clarify, correct or change the Bidding Documents or the Contract Documents.

ARTICLE 8 - BID SECURITY

- 8.1 The OWNER will keep confidential bid information received from the General Contractor.
- 8.2 The General Contractor and his subcontractors shall in no case share pricing with other contractors and subcontractors.

ARTICLE 9 - CONTRACT TIME

- 9.1 The dates by which the Work is to be substantially completed and completed (the Contract Time) are set forth in the Agreement.

ARTICLE 10 - LIQUIDATED DAMAGES

- 10.1 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 - SUBSTITUTE MATERIALS AND EQUIPMENT

- 11.1 Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to OWNER, application for such acceptance will not be considered by OWNER until after the Effective Date of the Agreement.

ARTICLE 12 - SUBCONTRACTORS AND OTHERS

- 12.1 CONTRACTOR shall submit with the Bid to OWNER a list of all Subcontractors and other persons and organizations proposed for the Work. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, person and organization if requested by OWNER.

ARTICLE 13 - (Not Used)

ARTICLE 14 - PREPARATION OF BID

- 14.1 A Bid must be made on OWNER'S Bid Form.
- 14.2 Blank spaces in the Bid Form must be filled in correctly where indicated, and the Bidder must state, both in words and numerals, the prices proposed for each and every item of Work.

ARTICLE 15 - SUBMISSION OF BID

- 15.1 Bids shall be mailed, faxed or e-mailed as directed in bid invitation letter.

ARTICLE 16 - MODIFICATION OR WITHDRAWAL OF BID

ARTICLE 17 - OPENING OF BIDS

- 17.1 Bids will be opened privately.
- 17.2 Bids received by mail, fax or e-mail, or otherwise after the time specified for the opening of Bids will not be accepted and will be disqualified.

ARTICLE 18 - DISQUALIFICATION OF BIDDERS

ARTICLE 19 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 19.1 All Bids shall remain subject to acceptance for sixty days after the day of the Bid opening.

ARTICLE 20 - AWARD OF CONTRACT

- 20.1 OWNER reserves the right to reject any or all Bids, to waive any and all informalities not involving price, time or changes in the Work, to negotiate contract terms with the Successful Bidder and the right to reject all nonconforming, nonresponsive or conditional Bids.
- 20.2 OWNER reserves the right to reject any Bid if it shows any omissions, alterations of form, additions not called for, conditions or qualifications, or irregularities of any kind.
- 20.3 OWNER reserves the right to accept any Bid deemed to be in the best interests of the Project even though the Bid chosen may result in the award of the Contract to a Bidder whose Bid is not, on a mathematical basis alone, the low Bid.

ARTICLE 21 - CONTRACT SECURITIES

- 21.1 N/A

ARTICLE 22 - CONTRACTOR'S INSURANCE

- 22.1 Sample requirements provided.
- 22.2 The General Contractor shall carry builders risk insurance coverage for the duration of the project.

ARTICLE 23 - EXECUTION OF AGREEMENT

- 23.1 The Successful Bidder, or its authorized representative, will be required to execute the Agreement within ten days from the date of the Notice of Award.
- 23.2 The OWNER will prepare the documents, and will identify, in the Notice of Award, the location at which the documents will be executed.

ARTICLE 24 - NOTICE TO PROCEED

- 24.1 Issuance of the Notice to proceed shall be as stated in Article 2 of the General Conditions.

ARTICLE 25 - PRE-BID CONFERENCE

- 25.1 Bidders may be required to attend a Pre-Bid Conference at the discretion of the OWNER.

BID CLARIFICATIONS & ADDITIONS

Date

Valvoline Instant Oil Change
Sample Rd
USA

The following information is provided as supplementary to the bid construction drawings and specifications. This information is provided to clarify certain items in the bid documents and to provide inclusion of additional items not mentioned in the bid documents.

PROPOSAL REQUIREMENTS

- 1.
- 2.
- 3.

BUILDING

- 1.
- 2.
- 3.

SITE

- 1.
- 2.
- 3.

MISCELLANEOUS

- 1.

SECTION 00222 – Geotechnical Report

TO BE PROVIDED SEPARATELY BY OWNER

Description	Line Item Code	Sum	Amount	Comments
1 - Ground Up	Aggregate		\$0.00	
General Conditions	1		\$0.00	
Division 0 - General Conditions	1.2		\$0.00	
Temporary Facilities	1.2.1			
Temporary Utilities	1.2.2			
Insurance	1.2.3			
Supervision (On-site & Project Management)	1.2.4			
Materials Testing	1.2.5			
Permits	1.2.6			
Site Security	1.2.7			
Bond - If Required	1.2.8			
Permits - Misc. Contractor/ Trade Permits	1.2.9			
Tax	1.2.10			
Site Work	2		\$0.00	
Div 1 - Earthwork	2.2		\$0.00	
Building Demolition	2.2.1			
Foundation demolition	2.2.2			
Paving demolition	2.2.3			
Utility demolition	2.2.4			
Clearing & Grubbing	2.2.5			
Excavation	2.2.6			
Fill	2.2.7			
Topsail	2.2.8			
Rock Excavation	2.2.9			
Haul Off	2.2.10			
Construction Dewatering (Refer to Exhibit D)	2.2.11			
Soil Stabilization	2.2.12			
Erosion Control	2.2.13			
Div 2 - CONCRETE	2.3		\$0.00	
Concrete Curb	2.3.1			
Asphalt Curb	2.3.2			
Sidewalks	2.3.3			
Dumpster Pad and Apron	2.3.4			
Building Aprons	2.3.5			
Pylon Base	2.3.6			
Light Base	2.3.7			
Other	2.3.8			
Div 3 - PAVING	2.4		\$0.00	
Concrete Paving	2.4.1			
Asphalt Paving	2.4.2			
Concrete Driveway Approaches	2.4.3			
Striping & Directional Arrows	2.4.4			
Bumper Blocks	2.4.5			
Asphalt Seal Coating	2.4.6			
Div 4 - SITE UTILITIES	2.5		\$0.00	
Storm Sewer	2.5.1			
Manholes	2.5.2			
Catch Basins	2.5.3			
Water Main	2.5.4			
Sanitary Sewer	2.5.5			
Gas Line	2.5.6			
Electric Service	2.5.7			
Phone Service	2.5.8			
Pylon / Monument Sign Electrical	2.5.9			
Site Light Conduit & Electrical	2.5.10			
Site Camera Installation	2.5.11			
Div 5 - SITE MICELLANEOUS	2.6		\$0.00	
Landscaping (plants, fine grade, etc.)	2.6.1			
Turf Establishment (sod, seed, hydromulch, etc.)	2.6.2			
Trash Enclosure	2.6.3			
Steel Bollards	2.6.4			
Irrigation sprinklers	2.6.5			
Retaining Wall	2.6.6			
Screen Fence	2.6.7			
Other	2.6.8			
Building	3		\$0.00	
Appropriation - Building	3.1		\$0.00	
Appropriation - Building	3.1.1			
Div 6 - CONCRETE	3.2		\$0.00	
Footings/Foundation	3.2.1			
Concrete Building Slab	3.2.2			
Precast Concrete w/ Deck	3.2.3			
Composite Deck	3.2.4			
Other	3.2.5			
Div 7 - MASONRY	3.3		\$0.00	
Block	3.3.1			
Brick	3.3.2			
Stucco /EFIS	3.3.3			
Div 8 - METALS	3.4		\$0.00	
Structural Steel	3.4.1			
Pit Steel & Stairs	3.4.2			
Misc. Steel (Lintels, roof, deck, bollards etc.)	3.4.3			
Div 9 - WOOD & PLASTICS	3.5		\$0.00	
Rough Carpentry	3.5.1			
Finish Carpentry	3.5.2			
Cabinets & Counters	3.5.3			
Other	3.5.4			
Div 10 - THERMAL & MOISTURE PROTECTION	3.6		\$0.00	
Shingle Roof	3.6.1			
Other type:	3.6.2			
Drain Tile	3.6.3			
Sheet Metal Flashing	3.6.4			
Waterproofing	3.6.5			
Gutters & Down Spouts	3.6.6			
Insulation:	3.6.7			
Div 11 - DOORS & WINDOWS	3.7		\$0.00	
Overhead Doors	3.7.1			
Store Front (Door & Window)	3.7.2			
Hollow Metal Doors & Frames	3.7.3			
Finish Hardware	3.7.4			
Div 12 - FINISHES	3.8		\$0.00	
Interior Painting	3.8.1			
Exterior Painting	3.8.2			
Drywall	3.8.3			
Ceiling Tile	3.8.4			
Service Bay Floor Finish type:	3.8.5			
Waiting & Restroom Floor Finish	3.8.6			
Basement/Storage/ Floor Finish	3.8.7			
Exterior Finish Special	3.8.8			
FRP Wall Finish	3.8.9			
Div 13 - SPECIALTIES	3.9		\$0.00	
Floor Safe (Corporate Safe-Model MB2014K-SG4440)	3.9.1			
Shelving	3.9.2			
Toilet Accessories	3.9.3			
Lockers	3.9.4			
Installation of Owner Furnished Equipment	3.9.5			
Other	3.9.6			
Div 14 - MECHANICAL	3.10		\$0.00	
Radiant Heat or Electric Heat	3.10.1			
HVAC (Specify Type)	3.10.2			
Test & Balance	3.10.3			
Plumbing (Including oil/water separator, water cooler, hands free eye wash station)	3.10.4			
Oil Process Piping	3.10.5			
Sprinkler System (Fire) type:	3.10.6			
Fire Extinguishers	3.10.7			
Other	3.10.8			
Div 15 - ELECTRICAL	3.11		\$0.00	
Building Electrical (Incl. all Fixtures, wiring of site, bldg signs & phone/pos/security/camera)	3.11.1			
Other	3.11.2			
Winter conditions	3.12		\$0.00	
Winter conditions	3.12.1			
General Conditions	3.13		\$0.00	

General Conditions
Overhead & Profit
Overhead & Profit

3.13.1
3.14
3.14.1

\$0.00

**EQUAL OPPORTUNITY
CERTIFICATION AND AGREEMENTS**

I. EQUAL OPPORTUNITY CLAUSE

(Applicable to all contracts or purchase orders in excess of \$10,000).

Seller shall be bound by and agrees to the following provisions as contained in Section 202 of Executive Order 11246, to wit:

1. The Supplier/Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Supplier/Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action will include, but not be limited to the following: employment, upgrading, demotion, or transfer, recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Supplier/Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.
2. The Supplier/Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Supplier/Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.
3. The Supplier/Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer, advising the labor union or workers' representative of the Supplier/Contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notices in conspicuous places available to employees and applicants for employment.
4. The Supplier/Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
5. The Supplier/Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
6. In the event of the Supplier/Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations or orders, this Purchase Order/Contract may be canceled, terminated or suspended in whole or in part and the Supplier/Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.
7. The Supplier/Contractor will include the provisions of paragraphs (1) through (7) in every Subcontract or Purchase Order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each Subcontractor or Vendor. The Supplier/Contractor will take such action with respect to any Subcontract or Purchase Order as may be directed by the Secretary of Labor as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the Supplier/Contractor becomes involved in, or is threatened with, litigation with a Subcontractor or Vendor as a result of such direction the Supplier/contractor may request the United States to enter into such litigation to protect the interests of the United States.

II. CERTIFICATION OF NON-SEGREGATED FACILITIES

Supplier/Contractor certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this contract. As used in this certification, the term "segregated facilities" means, but is not limited to, any waiting rooms, work areas, rest rooms, and wash rooms, restaurants and other eating areas, time clocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit direction or are in fact segregated on the basis of race, creed, color or national origin, because of habit, local custom, or otherwise. It further certifies that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts which are not exempt from the provisions of the Equal Opportunity Clause; that it will retain such certification in its files; and that it will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods).

"NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NON-SEGREGATED FACILITIES"

A certification of Non-segregated Facilities must be submitted before the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity Clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semi-annually or annually).

Note: The penalty for making false statements in offers is prescribed in 18 U.S.C 1001.

III. EMPLOYER INFORMATION REPORT AND AFFIRMATIVE ACTION PROGRAM

Supplier/Contractor agrees that if the amount of this contract is \$50,000 or more and it employs 50 or more persons it shall:

- (a) File with the Office of Federal Contract Compliance or agency designated by it, a complete and accurate report on Standard Form 100 (EEO-1) within 30 days after receiving an award of this contract (unless such a report has been filed in the last 12 months), and continue to file such reports annually, on or before March 31st.
- (b) Develop and maintain a written affirmative action compliance program for each of its establishments in accordance with the regulations of the Secretary of Labor promulgated under Executive Order 11246, as amended.

IV. AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA

(applicable to all contracts or purchase orders in excess of \$10,000)

- (a) The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or Veteran of the Vietnam era in regard to any position for which the employee or applicant for employment is qualified. The contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified disabled veterans and veterans of the Vietnam era without discrimination based upon their disability or veterans status in all employment practices such as the following: Employment upgrading, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

- (b) The contractor agrees that all suitable employment openings of the contractor which exist at the time of the execution of this contract and those which occur during the performance of this contract, including those not generated by this contract and including those occurring at an establishment of the contractor other than the one wherein the contract is being performed but excluding those of independently operated corporate affiliates, shall be listed at an appropriate location office of the State employment service system wherein the opening occurs. The contractor further agrees to provide such reports to such local office regarding employment openings and hires as may be required.

State and local government agencies holding Federal contracts of \$100,000 or more shall also list all their suitable openings with the appropriate office of the State employment service. but are not required to provide those reports set forth in paragraphs (d) and (e).

- (c) Listing of employment openings with the employment service system pursuant to this clause shall be made at least concurrently with the use of any other recruitment source or effort and shall involve the normal obligations which attach to the placing of a bona fide job order, including the acceptance of referrals of veterans and non-veterans. The listing of employment openings does not require the hiring of any particular job applicant or from any particular group of job applicants, and nothing herein is intended to relieve the contractor from any requirements in Executive Orders or regulations regarding nondiscrimination in employment.
- (d) The reports required by paragraph (b) of this clause shall include, but not be limited to, periodic reports which shall be filed at least quarterly with the appropriate local office or, where the contractor has more than one hiring location in a State, with the central office of that State employment service. Such reports shall indicate for each hiring location (1) the number of individuals hired during the reporting period, (2) the number of non-disabled veterans of the Vietnam era hired, (3) the number of disabled veterans of the Vietnam era hired, and (4) the total number of disabled veterans hired. The reports should include covered veterans hired for on-the-job training under 38 U.S.C. 1787. The contractor shall submit a report within 30 days after the end of each reporting period wherein any performance is made on this contract identifying data for each hiring location. The contractor shall maintain at each hiring location copies of the reports submitted until the expiration of one year after final payment under the contract, during which time these reports and related documentation shall be made available, upon request, for examination by any authorized representatives of the contracting officer or of the Secretary of Labor. Documentation would include personnel records respecting job openings, recruitment and placement.
- (e) Whenever the contractor becomes contractually bound to the listing provisions of this clause, it shall advise the employment service system in each State where it has establishments of the name and location of each hiring location in the State. As long as the contractor is contractually bound to these provisions and has so advised the State system, there is no need to advise the State system of subsequent contracts. The contractor may advise the State system when it is no longer bound by this contract clause.
- (f) This clause does not apply to the listing of employment openings which occur and are filled outside of the 50 States, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands.
- (g) The provisions of paragraphs (b), (c), (d), and (e) of this clause do not apply to openings which the contractor proposes to fill from within his own organization or to fill pursuant to a customary and traditional employer-union hiring arrangement. This exclusion does not apply to a particular opening once an employer decides to consider applicants outside of his own organization or employer-union arrangement for that opening.
- (h) As used in this clause:

- (1) “All suitable employment openings” includes, but is not limited to, openings which occur in the following job categories: Production and non-production; plant and office; laborers and mechanics; supervisory and non-supervisory; technical; and executive, administrative and professional openings as are compensated on a salary basis of less than \$25,000 per year. This term includes full-time employment, temporary employment of more than 3 days’ duration, and part-time employment. It does not include openings which the contractor proposes to fill from within his own organization or to fill pursuant to a customary and traditional employer-union hiring arrangement nor openings in an educational institution which are restricted to students of that institution. Under the most compelling circumstances an employment opening may not be suitable for listing, including such situations where the needs of the Government cannot reasonably be otherwise supplied, where listing would be contrary to national security, or where the requirement of listing would otherwise not be for the best interest of the Government.
 - (2) “Appropriate office of the State employment service system” means the local office of the Federal-State national system of public employment offices with assigned responsibility for serving the area where the employment opening is to be filled, including the District of Columbia, Guam, Puerto Rico. and the Virgin Islands.
 - (3) “Openings which the contractor proposes to fill from within his own organization” means employment openings for which no consideration will be given to persons outside the contractor’s organization (including any affiliates, subsidiaries, and the parent companies) and includes any openings which the contractor proposes to fill from regularly established “recall” lists.
 - (4) “Openings which the contractor proposes to fill pursuant to a customary and traditional employer-union hiring arrangement” means employment openings which the contractor proposes to fill from union halls, which is part of the customary and traditional hiring relationship which exists between the contractor and representatives of his employees.
- (i) The contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant to the Act.
 - (j) In the event of the contractors noncompliance with the requirements of this clause, actions for noncompliance may be taken in accordance with the rules, regulations. and relevant orders of the Secretary of Labor issued pursuant to the Act.
 - (k) The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the Director, provided by or through the contracting officer. Such notice shall state the contractor’s obligation under the law to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era for employment, and the rights of applicants and employees.
 - (l) The contractor will notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the contractor is bound by the terms of the Vietnam Era Veterans Readjustment Assistance Act, and is committed to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era.
 - (m) The contractor will include the provisions of this clause in every subcontract or purchase order of \$10,000 or more unless exempted by rules, regulations, or orders of the Secretary issued pursuant to the Act, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the Director of the Office of Federal Contract Compliance Programs may direct to enforce such provisions, including action for noncompliance.

**V. UTILIZATION OF SMALL BUSINESS
CONCERNS AND SMALL
DISADVANTAGED BUSINESS CONCERNS**

- (a) It is the policy of the United States that small business concerns and small business concerns owned and controlled by socially and economically disadvantaged individuals shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns and small business concerns owned and controlled by socially and economically disadvantaged individuals.
- (b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.
- (c) As used in this contract, the term "small business concern" shall mean a small business as defined pursuant to section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. The term "small business concern owned and controlled by socially and economically disadvantaged individuals" shall mean a small business concern (1) which is at least 51 percent unconditionally owned by one or more socially and economically disadvantaged individuals, or, in the case of any publicly owned business, at least 51 per centum of the stock of which is unconditionally owned by one or more socially and economically disadvantaged individuals; and (2) whose management and daily business operations are controlled by one or more of such individuals. This term also means a small business concern that is at least 51 percent unconditionally owned by an economically disadvantaged Indian tribe or Native Hawaiian organization, or a publicly owned business having at least 51 percent of its stock unconditionally owned by one of these entities which has its management and daily business controlled by members of an economically disadvantaged Indian Tribe or Native Hawaiian Organization, and which meets the requirements of 13 CFR 124. The Contractor shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Subcontinent Asian Americans, and other minorities, or any other individual found to be disadvantaged by the Administration pursuant to section 8(a) of the Small Business Act. The Contractor shall presume that socially and economically disadvantaged entities also include Indian Tribes and Native Hawaiian Organizations.
- (d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as either a small business concern or a small business concern owned and controlled by socially and economically disadvantaged individuals.

VI. UTILIZATION OF WOMEN-OWNED SMALL BUSINESSES

- (a) It is the policy of the United States that women-owned small businesses shall have the maximum practicable opportunity to participate in performing contracts awarded by any federal agency.
- (b) The contractor agrees to use its best efforts to give women-owned small businesses the maximum practicable opportunity to participate in the subcontracts it awards to the fullest extent consistent with the efficient performance of its contract.

VII. AFFIRMATIVE ACTION FOR HANDICAPPED WORKERS
(applies to all contracts or purchase orders in excess of \$2,500)

- (a) The contractor will not discriminate against any employee or applicant for employment because of physical or mental handicap in regard to any position for which the employee or applicant for employment is qualified. The contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices such as the following: Employment, upgrading, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.
- (b) The contractor agrees to comply with the rules, regulations and relevant orders of the Secretary of Labor issued pursuant to the Act.
- (c) In the event of the contractor's noncompliance with the requirements of this clause, actions for noncompliance may be taken in accordance with the rules, regulations, and relevant orders of the Secretary of Labor. issued pursuant to the Act.
- (d) The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the Director provided by or through the contracting officer. Such notices shall state the contractor's obligation under the law to take affirmative action to employ and advance in employment qualified handicapped employees and applicants for employment, and the rights of applicants and employees.
- (e) The contractor will notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the contractor is bound by the terms of section 503 or the Rehabilitation Act of 1973, and is committed to take affirmative action to employ and advance in employment physically and mentally handicapped individuals.
- (f) The contractor will include the provisions of this clause in every subcontract or purchase order of \$2,500 or more unless exempted by rules, regulations, or orders of the Secretary issued pursuant to section 503 of the Act, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the Director of the Office of Federal Contract Compliance Programs may direct to enforce such provisions, including action for non-compliance.

Company Name:

Address:
City, State, Zip:
United States

Date:

Agreed to and Certified By:

Authorized Signature

Name of Authorized Representative

TITLE OF AUTHORIZED REPRESENTATIVE

CONTRACTOR SAFETY AND HEALTH REGULATIONS

Accident, fire and exposure prevention are essential elements in the operation of all Valvoline LLC., its subsidiaries and affiliates (herein called "Valvoline") plants, All personnel, independent contractors and visitors, while within the confines of our plants, are required to wear certain protective equipment and comply with established safety and health regulations. Independent contractors, performing work or services at any company facility under contract from Valvoline, are expected to perform all work or services in a safe, healthful and efficient manner, so as to prevent injury to their employees or damage to their equipment and to protect Valvoline's employees and property.

All independent contractors, under their contract with Valvoline, have agreed to adhere to and abide by the General Fire, Safety and Health Regulations promulgated by Valvoline with respect to contractor work. The purpose of this memorandum and the Regulations attached hereto is to familiarize the contractor with these Regulations so he may become aware of the requirements expected of him and take steps to educate his employees with respect to their on-the-job conduct.

To promote safe work and to develop safety and health awareness in the workpeople, we feel that safety meetings are important. A short "tailgate" meeting each morning will contribute greatly to this. Naturally, follow-up by supervisors during daily contact should be done.

After you have had an opportunity to review the attached Regulations, representatives of this Department will be happy to discuss with you any questions you may have concerning your particular work or service.

CONTRACTOR: SIGN HERE

I have read and understand the Contractor Safety and Health Regulations cited above and I certify that Valvoline has advised me, in accordance with the Federal Hazard communication standard, as to the hazards, if any, associated with chemicals located in the workplace to which the Contractor's employees may be exposed.

signed for contractor by:

signature

title

name of contracting firm:

date

GENERAL FIRE, SAFETY AND HEALTH REGULATIONS CONTRACT WORK

1. SMOKING:

Smoking is absolutely prohibited at all times in locations where **NO SMOKING** signs are exhibited

No smoking is permitted inside the plant property fenced area other than in designated smoking areas. A special smoking area may be arranged by Valvoline's safety personnel for contract employees due to location and number of employees.

2. FIRE PROTECTION

A permit to perform hot work of any kind is required at all locations in the plant other than in Company shop buildings. Special hot work permits can be obtained for contractor welding at fabrication sites; however, all other hot work will require a hot work permit which can be obtained from a person designated by local safety personnel, and in no event will hot work be performed until such permit is granted.

The contractor shall furnish approved fire extinguishers for fire protection. If this equipment is to be furnished by Valvoline pursuant to the contract, it may be obtained from the local safety personnel.

Company fire equipment located throughout the plant should be used only in the event of a fire. This fire equipment must be kept in place and free from obstructions at all times.

The plant fire water systems are reserved for fire fighting purposes. If abnormal circumstances make it necessary that fire water be used for filling tanks, etc., special arrangements must be made with the company.

3. HOUSEKEEPING

The contractor shall be expected to maintain a clean work place at all times for the safety of his employees Valvoline employees and others.

A clean and tidy plant is a safe plant. Do not permit any refuse to accumulate. Pile material neatly and safely, keeping material a safe distance from fire fighting equipment, roads, sewer manholes, side-walks and operating facilities where employees have to travel to perform their work assignments. Do not leave tools and loose materials on steps, walkways, platforms or on elevated equipment. Place proper guard rails or barricades around openings, trenches and objects that protrude into walkways or roadways. The contractor is required to furnish labor needed to keep area clean, including workers' lunch refuse.

4. SAFETY

The contractor shall be expected to perform safe work at all times. All personnel within the confines of our plants, including visitors, and contractors and their employees, agents or representatives, are required to wear safety hats and proper eye protection. It is the responsibility of the contractors to insure personal protective equipment is provided and worn by their employees.

To prevent personal injury, scaffolding and shoring should be provided where work to be performed requires it, to protect against falls, falling objects and cave-ins. Regulation handrails, toe boards and ladders must be provided where necessary or required. When working above ground, safety belts shall be worn as required. Do not throw or drop tools or equipment. Install signs and rope off areas in which there is danger from falling objects.

Guy wires, hoisting cables or tackle lines shall not be anchored to in-service pipe lines or equipment vulnerable to stress.

Electrical equipment tie-ins must be coordinated with Valvoline's operations. Electrical problems should be worked out to the best safe advantage by the contractor's and company's electrical departments. Electric lockout procedure shall be followed when working on any electric equipment.

A vessel entry permit must be obtained by Contractor foremen for work to be performed in tanks, vessels, sewer manholes and similar confined areas.

Only authorized contractor vehicles will be permitted in the plant. No vehicle shall be driven in excess of 15 miles per hour. Special permits will be required when vehicles are needed in operating unit areas, inside tank dike walls, etc.

5. OSHA

All contractors will conform to and comply with the guidelines and regulations promulgated by OSHA pursuant to the Occupational Safety and Health Act as well as all other applicable Federal, State and Local laws and safety and health regulations. All references contained within the statement of safety and health regulations as to proper equipment and as to methods of operation are based upon the Regulations and Standards recited in the Federal Occupational Safety and Health Act, and promulgated pursuant thereto.

6. GENERAL

It is understood that the above general rules and regulations, plus other specific safety and health practices that may be instituted from time to time, are included in the conditions agreed to by the contract at the time of signing the contract for the work involved.

7. FEDERAL HAZARD COMMUNICATION

Valvoline has an affirmative duty, imposed by the Federal Hazard Communication Standard (48 FR 5334), to fully advise contractor as to the hazards, if any, of exposure to chemicals associated with contractor's work in the workplace.

Valvoline shall comply with this requirement by providing all necessary information with respect to such hazards to appropriate Contractor's representative before Contractor's employees are permitted on-site to commence work.

SECTION 01011 - GENERAL CONDITIONS**TABLE OF ARTICLES**

1. Definitions
2. Preliminary Matters
3. Contract Documents: Intent and Reuse
4. Availability of Lands; Physical Conditions; Reference Points
5. Bonds and Insurance
6. Contractor's Responsibilities
7. Work by Others
8. Owner's Responsibilities
9. Engineer's Status During Construction
10. Changes in the Work
11. Change of Contract Price
12. Change of Contract Time
13. Warranty and Guarantee; Tests and Inspections; Correction, Removal or Acceptance of Defective Work
14. Payments to Contractor and Completion
15. Suspension of Work and Termination
16. Dispute Resolution
17. Miscellaneous

ARTICLE 1 - DEFINITIONS

- A)** Wherever used in these General Conditions or in the other Contract Documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof.

a. Defined Terms:

Addenda: Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change, the Bidding Documents or the Contract Documents.

Agreement: The written agreement between OWNER and CONTRACTOR covering the Work to be performed; all other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

Application for Payment: The form accepted by OWNER which is to be used by CONTRACTOR in requesting progress or final payment and which is to include such supporting documentation as is required by the Contract Documents.

Bid: The offer or proposal of the Bidder submitted on the prescribed form setting forth the price(s) for the Work to be performed.

Bidder: Any person, firm or corporation submitting a Bid for the Work.

Bidding Documents: Notice to bidders or advertisement, if any, instructions to bidders, other bidding information and requirements, bidding forms and attachments, contract and bond forms, and the proposed Contract Documents, including any Addenda issued prior to receipt of Bids.

Bonds: Bid, Performance, and Payment bonds and other instruments of security.

Change Order: A written order to CONTRACTOR signed by OWNER authorizing an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time issued after the Effective Date of the Agreement.

Contract Documents: The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR'S Bid (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications, the Drawings as the same may be more specifically identified in the Agreement, together with all Modifications issued after execution of the Agreement.

Contract Price: The moneys payable by OWNER to CONTRACTOR under the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.7 in the case of Unit Price Work).

Contract Time: The number of days (computed as provided in Paragraph 17.2) or the date stated in the Agreement for the completion of the Work.

CONTRACTOR: The person, firm or cooperation with whom OWNER has executed the Agreement. Whenever the Project is to be remediated under multiple direct contracts, the term "CONTRACTOR" shall mean the appropriate prime CONTRACTOR. Whenever a specific prime CONTRACTOR is referred to, terms such as "General CONTRACTOR", "Electrical CONTRACTOR", etc. will be used.

day: A calendar day of twenty-four hours measured from midnight to the next midnight.

defective: An adjective which when modifying the Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to OWNER's recommendation for final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with Paragraph 14.5).

Drawings: The Drawings which show the character and scope of the Work to be performed and which have been prepared or approved by OWNER and are referred to in the Contract Documents.

Effective Date of the Agreement: The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

OWNER: The person, firm or cooperation named as such in the Agreement.

Field Order: A written order issued by OWNER which orders minor changes in the Work in accordance with Paragraph 10.2 but which does not involve a change in the Contract Price or the Contract Time.

General Requirements: Sections of Division 1 of the Specifications.

Modifications: (a) A written amendment of the Contract Documents signed by both parties, (b) a Change Order, or (c) a Field Order. A Modification may only be issued after the Effective Date of the Agreement.

Notice of Award: The written notice by OWNER to the apparent successful Bidder stating that upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

Notice to Proceed: A written notice given by OWNER to CONTRACTOR fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform his obligations under the Contract Documents.

OWNER: The public body or authority, corporation, association, partnership, or individual with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

Project: The total remediation of which the Work to be provided under the Contract Documents may be the whole or a part as indicated elsewhere in the Contract Documents.

Project Manual: The bound documentary information prepared for bidding and remediating the Project. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

N/A

Samples: Physical examples furnished by the CONTRACTOR to illustrate materials, equipment or workmanship, and to establish standards by which some portions of the Work will be judged.

Shop Drawings: All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for CONTRACTOR to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a manufacturer, fabricator, supplier or distributor and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

Specifications: Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

Subcontractor: An individual, firm or cooperation having a direct contract with the CONTRACTOR or with any Subcontractor for the performance of a part of the Work at the site.

Substantial Completion: The Work (or a specified part thereof) has progressed to the point where, in the opinion of OWNER the project is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if there be no such certificate issued, when final payment is due in accordance with

Paragraph 14.9.A. The terms "substantially complete" and "substantially completed" as applied to any Work refer to Substantial Completion thereof.

Supplementary Conditions: Modifications and additions to the General Conditions.

Unit Price Work: Work to be paid for on the basis of unit prices contained in the Contract Documents.

Work: The entire completed remediation or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, and all as required by the Contract Documents.

ARTICLE 2 - PRELIMINARY MATTERS

A) N/A

B) Copies of Documents

- a. OWNER shall furnish CONTRACTOR a disk of the bid and construction documents for hard copy reproduction by the CONTRACTOR.

C) Commencement of Contract Time; Notice to Proceed:

D) The Contract Time will commence to run on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement.

E) Starting the Project:

CONTRACTOR shall start to perform the Work on the date when the Contract Time commences to run, but no Work shall be done at the site prior to the date on which the Contract Time commences to run.

A) Before Starting Construction:

Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to OWNER any conflict, error or discrepancy which he may discover and shall obtain a written interpretation or clarification from OWNER before proceeding with any work affected thereby.

A) Preconstruction Conference

Within two days after the Effective Date of the Agreement, but before CONTRACTOR starts the Work at the site, a conference will be held for review and acceptance of the schedules, referred to in Paragraph 2.5.B, to establish procedures for handling Shop Drawings and other submittals and for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AND REUSE

A) Intent:

- a. The Contract Documents comprise the entire Agreement between OWNER and CONTRACTOR concerning the Work. They may be altered only by a Modification.

- b. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. If, during the performance of the Work, CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, he shall report it to OWNER in writing at once and before proceeding with the Work affected thereby.
- c. It is the intent of the Specifications and Drawings to describe a complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work that may reasonably be inferred from the Specifications or Drawings as being required to produce the intended result shall be supplied whether or not it is specifically called for, at no additional cost to OWNER.
- d. The Specifications may describe or the Drawings may show the general arrangement of an item of material or equipment when the actual details of said arrangement will vary with the source of the material or equipment. In such cases, CONTRACTOR shall bear all direct and indirect costs to accommodate the item of material or equipment furnished, whether the item of material or equipment is furnished by a manufacturer named in the Specifications or is furnished as an approved substitute or "or equal" item of material or equipment.
- e. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the code of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual or code in effect at the time of opening Bids. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall change the duties and responsibilities of OWNER, CONTRACTOR or any of their agents or employees from those set forth in the Contract Documents.
- f. The Contract Documents will be governed by the law of the place of the Project.

B) Re-use of Documents:

Neither CONTRACTOR nor any Subcontractor, manufacturer, fabricator, supplier or distributor shall have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents.

ARTICLE 4 – not used

ARTICLE 5 - BONDS AND INSURANCE – reference contract documents

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

A) Supervision and Superintendence:

- a. CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of

construction. CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.

- b. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER except under extraordinary circumstances. The superintendent will be CONTRACTOR'S representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

B) Labor, Materials and Equipment:

CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Supplementary Conditions, all Work at the site shall be performed during regular working hours. CONTRACTOR shall advise OWNER when work is planned for Saturday, Sunday or any legal holiday.

CONTRACTOR shall furnish all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances and all other facilities and incidentals necessary for the execution, testing initial operation and completion of the Work

All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by OWNER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind of materials and equipments.

All materials and equipment shall be applied, installed, connected, erected, used cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier or distributor, except as otherwise provided in the Contract Documents.

A) Substitutions:

Whenever materials or equipment are specified or described in the Drawings or Specifications by using the name of a proprietary item or the name of a particular manufacturer, fabricator, supplier or distributor, the naming of the item is intended to establish the type, function and quality required. The procedure for review by OWNER will be as set forth in Paragraphs 6.3.A.1 below and as supplemented in the General Requirements.

A) Requests for review of substitute items of material and equipment will not be accepted by OWNER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to OWNER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified.

B) Concerning Subcontractors:

CONTRACTOR shall not employ any Subcontractor or other person or organization (including those who are to furnish the principal items of materials or equipment), whether initially or as a substitute, against whom OWNER may have reasonable objection. A Subcontractor or other person or organization identified in writing to OWNER by CONTRACTOR prior to the Notice of Award and not objected to in writing by OWNER prior to the Notice of Award will be deemed acceptable to OWNER.

CONTRACTOR shall be fully responsible for all acts and omissions of his subcontractors and of persons and organizations directly or indirectly employed by them.

The Divisions and Sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or delineating the Work to be performed by any specific trade.

All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of OWNER.

A) Patent Fees and Royalties:

CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others.

A) Permits

Unless otherwise indicated in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary to complete the Work, which are applicable at the time of opening of Bid. CONTRACTOR shall also pay all charges of utility service companies for connections to the Work.

A) Laws and Regulations:

CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations applicable to the Work. Except where otherwise expressly required by applicable laws, ordinances, rules and regulations, OWNER shall be responsible for monitoring CONTRACTOR'S compliance with any laws, ordinances, rules or regulations.

If CONTRACTOR observes that the Specifications or Drawings are at variance with any laws, ordinances, rules and regulations, CONTRACTOR shall give OWNER prompt written notice thereof, and any necessary changes shall be adjusted by an appropriate Modification.

A) Taxes

CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by him in accordance with the law of the place of the Project.

A) Use of Premises:

CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workmen to areas permitted by law, ordinances, permits, or the requirements of the Contract Documents, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment.

During progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER. CONTRACTOR shall restore to their original condition those portions of the site not designated for alteration by the Contract Documents.

CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

A) Record Documents

CONTRACTOR shall keep one record copy of all Specifications, Drawings, Addenda, Modifications, Shop Drawings and Samples at the site in good order and annotated to show all changes made during the construction process. These shall be available to OWNER for examination and shall be delivered to OWNER upon completion of the Work.

A) Safety and Protection:

CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the safety of, and shall provide the necessary protection to prevent damage, injury or loss.

CONTRACTOR shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

Safety Representative:

A) CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

Hazardous Communication Programs:

- A)** CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with laws, ordinances, rules, or regulations.

B) Shop Drawings and Samples:

After checking and verifying all field measurements, CONTRACTOR shall submit to OWNER for review and approval, in accordance with the accepted schedule of Shop Drawing submissions (see Paragraph 2.6) and the procedures specified in the General Requirements, copies of all Shop Drawings, which shall have been checked by and stamped with the approval of CONTRACTOR and identified as OWNER may require. The data shown on the Shop Drawings will be complete with respect to dimensions, design criteria, materials of construction and the like to enable OWNER to review the information as required.

Contractor shall also submit to OWNER for review and approval with such promptness as to cause no delay in Work, all Samples required by the Contract Documents.

At the time of each submission, CONTRACTOR shall in writing call OWNER's attention to all deviations that the Shop Drawings or samples may have from the requirements of the Contract Documents.

OWNER will review and approve with reasonable promptness Shop Drawings and Samples, but OWNER'S review and approval shall be only for conformance with the design concept of the project and for compliance given with the information given in the Contract Documents and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.

Where a Shop Drawing or Sample is required by the Specifications, no related Work shall be commenced until the submittal has been reviewed and approved by OWNER.

OWNER'S review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any deviations from the Contract Documents.

A) Continuing the work:

CONTRACTOR shall carry on the work and maintain the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements.

A) N/A

ARTICLE 7 - WORK BY OTHERS

- A) OWNER may perform additional work related to the Project by himself or have additional work performed by utility service companies, or let other direct contracts therefore which shall contain General Conditions similar to these.
- B) N/A
- C) CONTRACTOR shall do all cutting, fitting and patching of his Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of OWNER and the others whose work will be affected.
- D) If the performance of additional work by other contractors or utility service companies or OWNER was not noted in the Contract Documents, written notice thereof shall be given to CONTRACTOR prior to starting any such additional work.

ARTICLE 8 - not used**ARTICLE 9 – not used****ARTICLE 10 - CHANGES IN THE WORK**

- A) Without invalidating the Agreement and without notice to any surety OWNER may at any time or from time to time, order additions, deletions or revisions in the Work; these will be authorized by Change Orders. If any Change Order causes an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, an equitable adjustment will be made .
- B) OWNER may authorize minor changes in the Work not involving an adjustment in the Contract Price or the Contract Time which are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order. If CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or Contract Time, CONTRACTOR may make a claim therefor as provided in Article 11 or Article 12.
- C) Additional Work performed without authorization of a Change Order will not entitle CONTRACTOR to an increase in the Contract Price or an extension of the Contract Time.

ARTICLE 11 - CHANGE OF CONTRACT PRICE

- A) The Contract Price Constitutes the total compensation (subject to authorized adjustments payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at his expense without change in the Contract Price.
- B) The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contract Price shall be based on written notice delivered to OWNER within five days of the occurrence of the event giving rise to the claim. **Change orders not exceed 10% O&P or state for GC to obtain a mutually acceptable fixed fee with the VIOC PM**
- C) The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price will be determined as follows:

- a. Where the work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved.
- b. Where the Work involved is not covered by unit prices contained in the Contract Documents, by mutual acceptance of a lump sum.
- c. Where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 11.3.B, on the basis of the Cost of the Work (determined as provided in Paragraph 11.4) plus a Contractor's Fee for overhead and profit (determined as provided in Paragraph 11.5).
- d. Whenever the cost of any Work is to be determined pursuant to Paragraphs 11.4.A and 11.4.B, CONTRACTOR will submit in form acceptable to OWNER, an itemized cost breakdown together with supporting data.

D) Cost of Work:

The term Cost of the Work shall not include any of the following:

- A)** Payroll costs and other compensation of CONTRACTOR'S officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, lawyers, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by CONTRACTOR.

B) Contractor's Fee:

The Contractor's Fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

- A)** A mutually acceptable fixed fee;
- B)** If a fixed fee cannot be agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - i) For costs incurred under Paragraphs 11.4.A.1 and 11.4.A.2, the Contractor's Fee shall not exceed a total of fifteen percent (for overhead and for profit).
 - ii) N/A
 - iii) No fee shall be payable on the basis of costs itemized under Paragraphs 11.4.A.4, 11.4.A.5 and 11.4.B.
 - iv) The amount of credit to be allowed by CONTRACTOR to OWNER for any such change which results in a net decrease in cost, will be the amount of the net decrease plus a deduction in Contractor's Fee by an amount equal to ten percent of the net decrease.
 - v) When both additions and credits are involved in any one change, the adjustment in Contractor's Fee shall be computed on the basis of the net change in accordance with Paragraphs 11.5.A.2.a through 11.5.A.2.d, inclusive.

C) N/A

N/A

A) Unit Price Work:

Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

ARTICLE 12 - CHANGE OF THE CONTRACT TIME – reference contract documents.

ARTICLE 13 - WARRANTY AND GUARANTEE; TESTS AND INSPECTION; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

A) Warranty and Guarantee:

- a. CONTRACTOR warrants and guarantees to OWNER that all Work will be in accordance with the Contract Documents and will not be defective. Reasonably prompt notice of all defects after discovery shall be given to CONTRACTOR. All defective Work, whether or not in place, may be rejected or corrected as provided in this Article 13. General Contractor's shall provide the Owner with a warranty for all labor and materials provided by him and his subcontractors for a period of one (1) year from the project substantial completion date as set forth in the 100% inspection report. This warranty shall include the cost of all labor and materials requested to correct defects in materials and workmanship for the period specified.

B) Access to Work:

OWNER and OWNER'S representatives testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable time for their observation, inspection and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR'S site safety procedures and programs so that they may comply therewith as applicable.

If any law, ordinance, rule, regulation, code or orders of any public body having jurisdiction requires any Work (or part thereof) to specifically be inspected, tested or approved, OWNER (unless another party is specified in the General Requirements) shall assume full responsibility therefor, pay all costs in connection therewith and furnish the required certificates of inspection, testing or approval. CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required by the Specifications in connection with OWNER'S acceptance of a manufacturer, fabricator, supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR'S purchase thereof for incorporation in the Work. The cost of all other inspections, tests and approvals required by the Contract Documents shall be paid by OWNER (unless otherwise specified).

All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any public body having jurisdiction shall be performed by organizations acceptable to OWNER.

If any Work that is to be inspected, tested or approved is covered without written concurrence of OWNER, it must, if requested by OWNER, be uncovered for observation. Such uncovering shall be at CONTRACTOR'S expense unless CONTRACTOR has given OWNER timely notice of CONTRACTOR'S intention to cover such Work and OWNER has not acted with reasonable promptness in response to such notice.

Neither observations by OWNER nor inspections, tests or approvals by others shall relieve CONTRACTOR from his obligations to perform the Work in accordance with the Contract Documents.

A) Uncovering Work:

If any Work is covered contrary to the written request of OWNER, it must, if requested by OWNER be uncovered for OWNER'S observation and replaced at CONTRACTOR'S expense.

A) Owner May Stop the Work:

If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to finish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work.

A) Correction or Removal of Defective Work:

If required by OWNER, CONTRACTOR shall promptly, without cost to OWNER and as specified by OWNER, either correct any defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by OWNER, remove it from the site and replace it with non-defective Work.

A) Warranty Inspection

Warranty Inspection: Approximately ten (10) months following the project substantial completion date the OWNER will perform a warranty inspection. During inspection a warranty inspection report will be compiled listing all items found to be defective as a result of inferior materials and/or workmanship (exclusive of normal wear and tear or obvious abuse) from initial construction. The CONTRACTOR will be notified, in writing, of such defects.

A) One Year Correction Period:

If, within one year after the date of Substantial Completion or such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents, any Work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER'S written instructions either correct such defective Work or, if it has been rejected by OWNER, remove it from the site and replace it with non-defective Work. CONTRACTOR shall make corrections to defective work within 30 calendar days of notification by OWNER. If the CONTRACTOR does not comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or the rejected Work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by CONTRACTOR.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

A) Schedules

B) Application for Progress Payment

C) Contractor's Warranty of Title:

- a. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any application for Payment, whether incorporated in the Project or not, will pass to OWNER at the time of payment free and clear of all liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens").

D) Review of Applications for Progress Payments

E) Substantial Completion

F) Partial Utilization:

Use by OWNER of completed portions of the Work may be accomplished prior to Substantial Completion of all the Work subject to the following:

- A)** OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any part of the Work which OWNER believes to be substantially complete.
- B)** In lieu of the issuance of a Certificate of Substantial Completion as to part of the Work, OWNER may take over operation of a facility constituting part of the Work whether or not it is substantially complete if such facility is functionally and separately usable.

C) Final Inspection

Upon written notice from CONTRACTOR that the Work is complete, ENGINEER will make a final inspection with OWNER and contractor and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

ARTICLE 15 – not used

ARTICLE 16 - not used

ARTICLE 17 – not used

SECTION 01091 - REFERENCE STANDARDS**1.0 GENERAL****1.01 SCOPE**

- A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the Work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:
- 1) American Association of State Highway and Transportation Officials
 - 2) American Concrete Institute.
 - 3) American Gear Manufacturers Association.
 - 4) American Institute of Steel Construction.
 - 5) American Iron and Steel Institute.
 - 6) American National Standards Institute.
 - 7) American Society of Heating, Refrigerating and Air Conditioning Engineers.
 - 8) American Society of Mechanical Engineers.
 - 9) American Society for Testing and Materials.
 - 10) American Water Works Association.
 - 11) American Welding Society.
 - 12) Concrete Reinforcing Steel Institute.
 - 13) Factory Mutual Association.
 - 14) Institute of Electrical and Electronics Engineers.
 - 15) National Electrical Manufacturer's Association.
 - 16) Occupational Safety and Health Act.
 - 17) National Fire Protection Association.
 - 18) Prestressed Concrete Institute.
 - 19) Underwriters' Laboratories, Inc.
 - 20) New Jersey Administrative Code.
 - 21) Uniform Constructive Code.
 - 22) Building Officials and Code Administration.
 - 23) All other applicable standards listed in the Specifications, and the standards of utility service companies, where applicable.

SECTION 01092 - ABBREVIATIONS AND SYMBOLS**1.0 ABBREVIATIONS**

A. Common abbreviations which may be found in the Specifications are:

alternating current	a-c	maximum	max
ante meridian	a.m.	mercury	Hg
ampere	A	milligram	mg
average	avg	milligrams per liter	mg/l
		milliliter	ml
biochemical oxygen demand	BOD	millimeter	mm
brake horsepower	bhp	million gallon	mil
British thermal unit	BTu	million gallons per day	mgd
		minimum	min
Centigrade	C	net positive suction head	npsh
company	Co	number	no.
cubic inch	cu in	National Pipe Threads	NPT
cubic foot	cu ft		
cubic yard	cu yd	ounce	oz
cubic feet per minute	cfm		
cubic feet per second	cfs		
outside diameter	OD		
decibel	db	parts per million	ppm
degree Centigrade (or Celsius) (say)	20 C	plus or minus	(±)
degree Fahrenheit (say)	68 F	post meridian	p.m.
diameter	diam	pound	lb
direct current	d-c	pounds per square foot	psf
dollars	\$	pounds per square inch	psi
		pounds per square inch absolute	psia
each	ea		
efficiency	eff		
pounds per square inch gage	psig		
Fahrenheit	F	revolutions per minute	rpm
feet	ft		
feet per hour	fph		
feet per minute	fpm	second	sec
feet per second	fps	specific gravity	sp gr
figure	Fig.	square	sq
flange	flg	square foot	sq ft
foot-pound	ft-lb	square inch	sq in
square yard	sq yd		
gallon	gal	standard	std
gallons per minute	gpm	standard cubic feet per minute	scfm
gallons per second	gps		
gram	g		
Hertz	Hz	total dynamic head	TDC
hour	hr	totally-enclosed-	tefc
horsepower	hp		

		fan-cooled	
inch	in.	volt	V
inch-pound	in.-lb		
inside diameter	ID	microgram/kilogram	ug/kg
Action level guideline	ALG		
kilovolt-ampere	kva	parts per billion	ppb
kilowatt	kw		
kilowatt-hour	kwh		
linear foot	lin ft		
liter	l		

2.0 ORGANIZATION ABBREVIATIONS

A. Abbreviations of organizations which may be used in these Specifications are:

ACS	American Chemical Society
ACI	American Concrete Institute
AGMA	American Gear Manufacturers Association
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APHA	American Public Health Association
AREA	American Railway Engineering Association
ASTM	American Society for Testing and Materials
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
AWWA	American Water Works Association
AWS	American Welding Society
BOCA	Building Officials and Code Administration
DIPRA	Ductile Iron Pipe Research Association
CRSI	Concrete Reinforcing Steel Institute
ECRA	Environmental Cleanup Responsibility Act
EPA	Environmental Protection Agency
FM	Factory Mutual
HEW	Department of Health, Education and Welfare
HUD	Department of Housing and Urban Development
IEEE	Institute of Electrical and Electronic Engineers
IRI	Industrial Risk Insurance
ISO	Insurance Services Office
NAAMM	National Association of Architectural Metal Manufacturers
NARUC	National Association of Railroad and Utilities Commissioners
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NJAC	New Jersey Administrative Code
NJDEPE	New Jersey Department of Environmental Protection and Energy
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Precast Concrete Institute
SMACNA	Sheet Metal and Air Conditioning National Association
SSPC	Steel Structures Painting Council
UCC	Uniform Construction Code

UL	Underwriters Laboratories, Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USPHS	United States Public Health Service
WWEMA	Water and Wastewater Equipment Manufacturers Association
WPCF	Water Pollution Control Federation

3.0 LEGEND

- A. Legends of symbols used are shown on the Drawings, and in general, use of symbols is confined to the Drawings.

SECTION 01220 - PROGRESS MEETINGS

1.0 GENERAL

1.01 SCOPE

- A. Date and Time:
 - 1) Regular Meetings: As mutually agreed upon by OWNER and CONTRACTOR.
 - 2) Other Meetings: On call.
- B. Place: OWNER'S office at Project site or other mutually agreed upon location.
- C. OWNER shall prepare agenda, preside at meetings, and prepare and distribute a transcript of proceedings to all parties.
- D. CONTRACTOR shall provide data required and be prepared to discuss all items on agenda.

1.02 MINIMUM ATTENDANCE

- A. CONTRACTOR:
 - 1) When needed for the discussion of a particular agenda item, CONTRACTOR shall require representatives of Subcontractors or suppliers to attend meeting
- B. OWNER'S representative, if required.
- C. Others as appropriate.
- D. Representatives present for each party shall be authorized to act on their behalf.

1.03 AGENDA

- A. Agenda may include, but will not necessarily be limited to, the following:
 - 1) Transcript of previous meeting.
 - 2) Progress since last meeting.
 - 3) Planned progress for next period.
 - 4) Problems, conflicts and observations.
 - 5) Change Orders.
 - 6) Status of Shop Drawings.
 - 7) Quality standards and control.
 - 8) Schedules, including off-site fabrication and delivery schedules. Corrective measures, if required.
 - 9) Coordination between parties.
 - 10) Safety concerns.
 - 11) Other Business.

SECTION 01340 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

1.0 GENERAL

1.01 SUBMITTALS

- A. Submit shop drawings, product data and samples required by Contract Documents, within 30 days after award of the Contract.
- B. Shop drawings shall be submitted directly to OWNER's representative.
- C. Shop drawings and/or manufacturer's product data submittals are required if the product or useage is different from that specified in the drawings. Submit four (4) copies to OWNER's representative for review and written approval. Do not proceed without OWNER approval.

1.02 SHOP DRAWINGS

- A. Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet and detail, schedule or room number shown on Contract Drawings. Provide reinforcing steel details, and structural steel shop drawings. Field measure all members to assure match to existing building.

1.03 SAMPLES

- A. Office samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of the product, with integrally related parts and attachment devices and the full range of color, texture and pattern.

SECTION 01341 - PROJECT COORDINATION

1.0 GENERAL

- A. As more fully set forth in Article 6 of the General Conditions, CONTRACTOR shall be solely responsible for coordination of all of the Work. He shall supervise, direct and cooperate fully with all Subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies and all others whose services, materials or equipment are required to ensure completion of the Work within the Contract Time. Each subcontractor shall be responsible to coordinate their work activity directly through the CONTRACTOR and with other trades not the OWNER.
- B. As more fully set forth in Article 7 of the General Conditions, CONTRACTOR shall cooperate with and coordinate his Work with the work of any other contractor, utility service company or OWNER'S employees performing additional work related to the Project at the site.
- C. CONTRACTOR shall not be responsible for damage done by contractors not under his jurisdiction. He will not be liable for any such loss or damage unless it is through the negligence of the CONTRACTOR.
- D. CONTRACTOR shall maintain sufficient competent personnel and supplies at the site for the purpose of preparing AS-BUILT drawings. The CONTRACTOR will ensure that each Subcontractor maintains AS-BUILT information pertinent to their specific work.
- E. CONTRACTOR shall also coordinate his Work with the work of others identified in Section 1A1, Article 1.3, to assure compliance with schedules.
- F. CONTRACTOR shall attend and participate in all project coordination or progress meetings and report on the progress of all Work and compliance with schedules.
- G. CONTRACTOR shall prepare and submit for OWNER review and approval all waste disposal applications, land ban notices, manifests, and associated transportation and disposal applications at least two (2) weeks prior to transportation of any waste materials off-site.
- H. CONTRACTOR shall coordinate all site work, transportation, and disposal activities to minimize downtime.

SECTION 01410 - INSPECTION, SAMPLING AND TESTING LABORATORY SERVICES

1.0 GENERAL

- A. The CONTRACTOR will employ and pay for an independent testing laboratory to perform the specified inspection, sampling and testing services. These include:
- 1) Soils Compaction, Division 31.
 - 2) Paving and Surfacing, Division 32.
 - 3) Concrete, Divisions 3 & 32.
- B. The testing laboratory is not authorized to approve or accept any portion of the Work; rescind, alter or augment the requirements of the Contract Documents; or perform any duties of the CONTRACTOR.

1.01 QUALIFICATIONS OF LABORATORY

- A. Where applicable, the testing laboratory will meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, published by American Council of Independent Laboratories and the basic requirements of ASTM E 329 "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction".

1.02 LABORATORY DUTIES

- A. Where applicable, the testing laboratory will:
- 1) Cooperate with OWNER and CONTRACTOR and provide qualified personnel promptly on notice.
 - 2) Perform specified inspections, sampling and testing of materials and methods of construction; comply with applicable standards; ascertain compliance with requirements of Contract Documents.
 - 3) Promptly notify OWNER and CONTRACTOR of irregularities or deficiencies of Work which are observed during performance of services.
 - 4) Promptly submit 5 copies of reports of inspections and tests to OWNER, including:
 - a) Date issued.
 - b) Project title and number.
 - c) Testing laboratory name and address.
 - d) Date of inspection or sampling.
 - e) Record of temperature and weather.
 - f) Date of test.
 - g) Identification of product and Specification Section
 - h) Location in Project.
 - i) Type of inspection or test.
 - j) Results of tests and observations regarding compliance with Contract Documents.
 - 5) Perform additional tests and services as required by OWNER.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The CONTRACTOR shall:
- 1) Cooperate with laboratory personnel, provide access to Work and to manufacturer's operations.
 - 2) Provide to laboratory, preliminary representative samples of materials to be tested, in required quantities.
 - 3) Furnish copies of product test reports.
 - 4) Provide to the laboratory the preliminary design mix proposed for concrete, and other material mixes that require testing by the testing laboratory.
 - 5) Furnish labor and facilities:
 - a) To provide access to Work to be tested.
 - b) To obtain and handle samples at the site.
 - c) To facilitate inspections and tests.

- d) For laboratory's exclusive use for storage and curing of test samples.
- e) Forms for preparing concrete test beams and cylinders.
- 6) CONTRACTOR shall coordinate testing with OWNER. Notify laboratory and OWNER sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
- 7) Arrange with laboratory and pay for, additional samples and tests required for CONTRACTOR'S convenience.

1.04 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Payment for these services will be paid by Owner.
 - 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 5. Submit copies of each written report directly to authorities having jurisdiction, when directed.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Owner and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.05 SPECIAL TESTS / INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Owner and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Owner with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

1.06 REPAIR / PROTECTION

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

- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

SECTION 01500 – TEMPORARY UTILITY SERVICES**1.0 GENERAL**

- 1.01 Utility Cost: The General Contractor shall include in the contract sum the cost of all utility services required for the project until the project final completion date as set forth in the 100% Final Inspection Report.
- 1.02 Provide the required temporary utility services to the project as set forth in these specifications and in compliance with all governing local codes and ordinances.
- 1.03 Provide potable water to the project for drinking and construction purposes from local/municipal service or other as applicable.
- 1.04 Temporary Heat: Where permanent mechanical systems are not yet operable, provide self-contained LP gas, fuel oil, or kerosene space heaters to maintain a temperature of 45 degrees F in the enclosed building. Provide adequate ventilation in these spaces.
- 1.05 Temporary Electrical: Provide a weatherproof, grounded electrical service as required until the building electrical operable.
- 1.06 Temporary Lighting: Provide temporary lighting of sufficient intensity and quality for the proper and safe performance of the work.
- 1.07 Temporary Sanitary Facilities: Provide temporary single occupant, self-contained toilet facilities in compliance with local regulations.
- 1.08 Temporary Telephone Service: Provide a minimum of one temporary telephone at project site with fax capability throughout construction. Notify the Owner's Representative of the telephone number/s as soon as service is connected.
- 1.09 Dewatering/Site Drainage: Maintain the project site construction work free of water accumulation and protect against flooding, "Do not endanger the work or adjacent properties."
- 1.10 Construction Debris: Collect and containerize all construction debris daily. Remove from project site as required and in compliance with local ordinances.

SECTION 01540 - PROJECT SECURITY & PROTECTION**GENERAL**

1.1. The Contractor shall be responsible for all violations of city codes, ordinances, and state laws involved in the performance of his Work; and for obstruction of streets, sidewalks, alleys, and pavements, and shall in all cases make good any damage to any streets, sidewalks, alleys and pavements. He shall use every precaution to brace and otherwise support and secure the structural frame, walls, floors and roof during the construction of the work; and shall provide, during the progress of his work, every and all safeguards and protection against accidents, injury and damage to persons and property including adjoining property. The Contractor shall be responsible for his work and every part thereof, and for all materials, tools, appliances and property of every description used in connection therewith.

1.2. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, water ways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noise-producing tools and equipment to hours that will minimize complaints from persons or firms near the site. The Contractor shall not use any fill or other materials to be incorporated into the Work that contain asbestos, are hazardous, toxic or are made up of materials that are hazardous or toxic materials as defined from time to time by applicable federal or state laws, rules, and regulations.

1.3. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

1.4. Enclosure Fence (if required): Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.

1.5. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

1.6. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA

1. Locate fire extinguishers where convenient and effective for their intended purpose.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.
4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

1.7. HOT WORK: Where Work involves the use of flame, spark or hot ember producing equipment, such as but not limited to, welding, blow torches and metal grinding type equipment and equipment using internal combustion engines ("Hot Work"). In order to prevent the potential for fires, Hot Work safety procedures must be followed that include, but shall not be limited to, the following elements: Pre-work inspection of the area to identify and minimize the presence of combustible or flammable materials, the use of flame resistant building surface coverings such as welding blankets and fire retardant tarpaulins (tarps), in the area of hot work, damping down the area, the presence of a functional dry chemical fire extinguisher with a minimum rating of 10B-C within 10 feet of the Hot Work area, and post-work inspection of the area for any signs of smoldering or burning materials and extinguishment of these materials. The Hot Work procedures will also highlight the need for extra caution for hot work in areas on the roof, near ventilation exhaust systems. These Hot Work procedures will be planned for, initiated and monitored through the use of written Hot Work permit, which will be signed by both the designated job site superintendent and the person performing the hot work. The Hot Work permit shall be posted in the work area and a copy provided to OWNER if requested.

SECTION 01610 - DELIVERY, STORAGE AND HANDLING

PART 1- GENERAL

- 1.01. Owner Supplied Equipment: The General Contractor shall be responsible for the receipt and storage of all materials and equipment, including owner supplied equipment. If the building is not complete at such time, the contractor shall provide proper storage facilities so as to prevent theft or damage to the equipment. Notify Owner promptly of any equipment that arrives damaged or is found to be defective
- 2.01. The General Contractor shall be responsible for the complete assembly and installation of all Owner supplied equipment as shown in the drawings, unless otherwise specifically stated. Final electrical and plumbing connections to said equipment shall be as stated in the applicable sections of the technical specifications.

SECTION 01700 – PROJECT CLOSEOUT**PART 1- GENERAL**

- 1.01. Record Documentation: Maintain the following for submittal to the Owner's Representative as set forth herein.
- 2.01. Record Drawings: Maintain a complete set of blue-line prints of contract drawings and shop drawings for record mark-up purposes throughout the contract time. Mark-up drawings during the course of the work to show changes and actual installation conditions, sufficient to serve as a complete record for Owner's purposes. Give particular attention to work which will be concealed and difficult to measure and record at a later date. General Contractor to provide a CD with scanned electronic images (PDFS) of completed marked up as built contract and shop drawings at the end of the project.
- 3.01. Maintenance Manuals: Provide 3-ring vinyl covered binder(s) containing required maintenance manuals, properly identified and indexed. Include operating and maintenance instructions; extended to cover emergencies, spare parts, warranties, inspection procedure diagrams, safety, security, and similar appropriate data for each system or equipment item.
- 4.01. Final Cleaning: Immediately prior to the date at the Final 100% Inspection: remove non-permanent protection and labels, polish glass, clean or replace filters of mechanical system, remove debris and thoroughly clean and mop facilities, clean light fixtures and replace burned-out / dimmed lamps, sweep and pressure wash paved areas, police yards and grounds, perform similar clean up operations needed to produce a "clean" condition as judged by Owner's Representative.
- 5.01. Procedures for Final Inspection
 - a. Prerequisites: Comply with General conditions and complete the following before requesting the 100% Final Inspection for the work:
 - b. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates and similar required certificates and similar required documentation for specific units of work enabling Owner's unrestricted occupancy and use.
 - c. Submit record documentation, main keys and similar operational items.
 - d. Complete instruction of Owner's operating personnel, and start up of systems.
 - e. Prepare a list containing the General Contractor's and all of his subcontractor's names, address, and phone numbers for the project. Give a copy of the list to the Owner's Representative and to the Instant Oil Change store manager.
 - f. Final inspection: After all prerequisites have been fulfilled, the General Contractor shall notify the Owner's Representative that the building is ready for Final Inspection.

SECTION 02060 - DEMOLITION**PART 1- GENERAL****1.01 SECTION INCLUDES**

- A. Demolition of existing buildings and site improvements
- B. Demolition of existing on-grade materials.
- C. Removal of below-grade construction (ie. underground storage tanks and related piping, footers, etc.)
- D. Removal of resulting debris.

1.02 RELATED SECTIONS

- A. Section 02110 - Site Clearing.
- B. Division 31 - Earthwork: For filling of voids caused by demolition.

1.03 QUALITY ASSURANCE

- A. Comply with all laws, rules and regulations of governmental authorities having jurisdiction over the demolition work.
- B. Provide protection for all persons and property in accordance with ANSI/NFPA 241-89 Safeguarding Building Construction and Demolition Operations.
- C. Obtain and pay for all permits and licenses.
- D. Provide rodent control as required.
- E. Conform to applicable codes for disposal of rubbish, tires, environmental hazardous waste and contaminated soils.
- F. Underground storage tanks and piping removal by licensed and/or certified contractors only.
- G. Comply with all regulatory procedures for UST removal.

1.04 PROJECT CONDITIONS

- A. Occupancy: Structures to be demolished will be vacated and discontinued in use prior to start of work.
- B. Condition of Structures: Owner assumes no responsibility for actual condition of structures to be demolished.
- C. Explosives: Use of explosives will not be permitted.
- D. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- E. Protection: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.
- F. Utility Services: Protect and maintain existing utility lines which are to remain in service to avoid interruption of these lines. Cap utility lines terminated by the demolition work in a manner approved by the governmental authorities and utility companies having jurisdiction.
- G. Fire Prevention: Perform the demolition work to prevent fires. Remove debris promptly. No materials shall be burned on the site.
- H. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

1.05 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.06 SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit informational report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.
 - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.
- C. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Shutoff and capping or re-routing of utility services.
- D. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by building demolition operations. Submit before the Work begins.
- E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.07 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.
- D. Predemolition Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

- A. Satisfactory Soils: Comply with requirements in Division 31 - Earthwork

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

- C. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
- D. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.02 PREPARATION

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
- C. Existing Utilities: Refer to Divisions 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- E. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.03 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated.
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.04 DEMOLITION

- A. Procedures for removal of any hazardous waste, asbestos, underground tanks or petroleum piping must be reviewed with the Owner's Construction Manager prior to starting any work.
- B. Demolish buildings, paving, walks, and curbs completely and remove from site. Use such methods as required to complete work within limitations of governing regulations.
 1. Demolish and remove below-grade construction including basements.
 2. Wet down all piled materials and materials being discharged into vehicles.
- C. Protect existing landscaping and structures which are not to be demolished.
- D. The concrete floor in the existing basements shall be broken to facilitate the movement of water through it. It may be left in place if broken up, but not otherwise disturbed. Place engineered fill to grade per section 31001.

3.05 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
 1. Remove below-grade construction, including basements, foundation walls, and footings, completely.
- D. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.
 1. Piping: Disconnect piping at unions, flanges, valves, or fittings.
 2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove materials resulting from the demolition work from the site to avoid creating a nuisance. Dispose of materials from the site on a daily basis to locations determined by the Contractor, at no additional cost to the Owner. Take possession of salvageable material and equipment as property of the Contractor and promptly remove from the site. Construction waste materials must be disposed of in an approved landfill.
- B. Waste disposal tickets must be submitted to the construction supervisor if requested.

3.07 REPAIR AND CLEANING

- A. Promptly repair damage to property of the Owner which is to remain in use, or that of any person, or persons on or off the site caused by the demolition work without additional expense to the Owner.
- B. Promptly repair damage to adjacent properties caused by the demolition work without additional expense to the Owner.

- C. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations, as directed by Owner's Construction Manager or governing authorities. Return adjacent areas to condition existing prior to start of work.

SECTION 02110 – SITE CLEARING**1.0 GENERAL****1.01 SECTION INCLUDES**

- A. Protection of existing trees and other site improvements designated to remain.
- B. Removal of trees and other vegetation.
- C. Topsoil stripping.
- D. Clearing and grubbing.
- E. Removal of above-grade improvements.
- F. Removal of below-grade improvements.

1.02 RELATED SECTIONS

- A. Section 02060 - Building Demolition
- B. Section 31001 - Earthwork

1.03 QUALITY ASSURANCE

- A. Comply with codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION**3.01 PREPARATION**

- A. Protection of Trees:
 - 1. Protect trees which are indicated on the Drawings to remain and those to be relocated. Material and debris shall not be piled under such trees. Extensive grading shall not be performed under such trees within the spread of the branches. Where trees are inadvertently damaged, damage to such trees shall be repaired by persons skilled in the care of trees. Protection shall be provided at tree drip line.
- B. Location and Protection of Utilities:
 - 1. Call local utility companies for locations prior to commencing.
 - 2. Protect existing service lines and related structures encountered in the clearing work. If damaged, repair such lines and structures or arrange for their repair with the proper authorities or companies.
- C. Protection of Site Improvements:
 - 1. Protect site improvements which are indicated on the Drawings to remain. Restore damaged improvements to their original condition.
- D. Damage to trees, utilities and other site improvements shall be corrected at no additional cost to Owner.
- E. Sediment and Erosion Control:
 - 1. Contractor shall provide hay bales or silt fence along the perimeter of the property or limits of the site clearing when required.
 - 2. Cautionary steps shall be taken to avoid erosion of any soils.

3.02 SITE CLEARING

- A. General: Remove trees, shrubs, grass and other vegetation, improvements, and obstructions interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated.
- B. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to remain.
 - 1. Completely remove stumps, roots, and other debris.
 - 2. Carefully and cleanly cut roots and branches of trees indicated to remain, where such roots and branches obstruct new construction.
 - 3. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 4. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact to a density in accordance with section 31001, Earthwork.
- C. Topsoil: Topsoil is defined as surface soil approved by Owners Construction Supervisor found in a depth of not less than 4". Satisfactory topsoil is reasonably free of subsoil, clay, lumps, stones, and other objects over 1 inch in diameter, and without weeds, roots and other objectionable material.
 - 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil and other objectionable material.
 - a. Remove heavy growths of grass from areas before stripping.
 - b. Where trees are indicated to remain, stop topsoil stripping a sufficient distance to prevent damage to surface root system.
 - 2. Stockpile topsoil in storage piles in areas shown, or where directed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust.
 - 3. Dispose of unsuitable and excess topsoil as specified for waste material.
- D. Remove existing on-grade and below-grade construction which may be encountered in areas to be occupied by new construction. In areas of general grading and areas which are to be paved, remove obstructions that may be encountered to a depth of at least 18" below the rough grades.
 - 1. Abandonment or removal of certain underground pipe and conduits may be shown on mechanical or electrical drawings (if any), and is included under work of those sections. Removal of abandoned underground piping and conduit interfering with construction is included under this Section.

3.03 DISPOSAL OF MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.
- B. Removal from Owner's Property: Remove unsuitable and excess topsoil from Owner's property and dispose of in an approved manner.

3.04 DUST CONTROL

- A. Use means necessary to control dust on and near the work if such dust is caused by the Contractor's operations during performance of the work or if resulting from the condition in which the Contractor leaves the site as required by applicable codes.
- B. Thoroughly moisten surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the site.

3.05 TRAFFIC CONTROL

- A. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities. Do not close or obstruct streets, walks and other occupied and used facilities without permission from authorities having jurisdiction.

- B. Any silt or mud tracked off the property by transporting vehicles shall be immediately removed by the contractor. Care should be taken to avoid any reoccurrence.

SECTION 02330 BENCHMARK AND SURVEY

GENERAL

SCOPE

- A. Prior to start of construction, CONTRACTOR shall confirm the accuracy of the Bench Mark indicated on Owner's drawings. CONTRACTOR shall immediately advise OWNER of any errors or discrepancies.
- B. Prior to start of construction, CONTRACTOR shall confirm the accuracy of property markers Indicated on OWNER's drawings. CONTRACTOR shall immediately advise OWNER of any errors or discrepancies. OWNER shall arrange for any survey corrections. It is the CONTRACTOR'S responsibility to preserve all property pins.
- C. CONTRACTOR is responsible for establishing all control points necessary for construction. OWNER is not providing any control points.

SECTION 03100 – CONCRETE FORMWORK**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Form work for building concrete.
- B. Forms for area lights, sign foundations and miscellaneous yard items.
- C. Form ties and accessories

1.02 RELATED SECTIONS

- A. Section 03200 - Concrete Reinforcement.
- B. Section 03300- Cast-In-Place Concrete.

1.03 QUALITY ASSURANCE

- A. Form work shall comply with "Recommended Practice for Concrete Form work" ACI 347R.
- B. Design criteria/construction tolerances shall comply with ACI 301.
- C. Anchor bolt tolerances shall comply with AISC "Code of Standard Practice" September 1, 1986, Paragraph 7.5.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Wood Form Sheathing:
 - 1. Finish No. 1 (Concealed Below Grade Concrete): 3/4" exterior plywood, B-B Concrete Form Class II, PS-1-83.
 - 2. Finish No. 2 (Exposed concrete): Same as for Finish No. 1.
 - 3. Finish No. 3 (Smooth Concrete): 3/4" exterior type, resin coated plywood, High Density concrete Form Overlay, Class I, PS-1-83.
- B. Chamfer Strips: 3/4" vinyl or wood with or without nailing flange at Contractor's option, No. G22 or 612 (Greenstreak Plastic Products Co.); No. CS-3/4 or CSN-3/4 (Vinylex Corp).
- C. Form Ties: Internal disconnect, or snap type, leaving metal no closer than 1" from surface of concrete or a hole no larger than 3/4" in diameter. Form ties shall be factory fabricated.
- D. Form Coating: A commercial product to facilitate stripping without staining or damaging concrete or impairing future concrete treatment.
- E. Sonotube fiber forms or approved equal may be used below ground when approved by Owner's Construction Manager.
- F. Earth cuts may be used as forms for vertical surfaces of footings when approved by Construction Supervisor.

PART 3 EXECUTION**3.01 CONSTRUCTION DETAILS FOR FORM WORK**

- A. Forms shall be thoroughly cleaned and shall conform to shape, lines and dimensions shown on the drawings, be designed to resist the pressure and weight of the concrete, be properly tied and braced or shored so as to maintain position and shape, and be sufficiently tight to prevent leakage of mortar. Forms shall be designed and constructed to facilitate easy removal without damage to exposed surfaces, and to provide smooth

concrete surfaces free of off-sets. Corners shall be true to lines and profiled as detailed. Form joints which will be exposed to view shall be kept to a minimum and shall be located symmetrically within each modular unit.

- B. Before reinforcing steel is set, wood forms shall be coated with an approved non-staining form oil, or wet with water (Except in freezing weather). Metal forms shall be coated with an approved non-staining rust preventive form oil. Stained forms shall not be used.
- C. Provide temporary openings to facilitate cleaning and inspection immediately before depositing concrete.
- D. Form material is subject to Owner's Construction Manager's approval before construction of forms. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to the Owner's Construction Manager's approval.
- E. Exposed corners shall be chamfered unless otherwise shown. Where corners are shown chamfered, wood, polyvinyl chloride or neoprene extruded corner strips shall be inserted in the forms. Corners which abut masonry walls shall not be chamfered.
- F. Place bulkheads where end of days work requires a joint in a concrete member. Reinforcing steel shall extend through the bulkhead. Joints shall be keyed for 1/2 of the member thickness unless otherwise directed. Location of bulkheads on structured or load bearing walls shall be as approved by the Owner's Construction Manager.
- G. Form openings in concrete as shown on the Drawings or required by other trades to accommodate their work. Accurately place and securely support items to be built into forms.
- H. Set and build into the Work the anchorage devices and other imbedded items required for other work that is shown on the Drawings attached to, or supported by, cast-in-place concrete. Coordinate location and placement with other trades.

3.02 FORM REMOVAL

- A. Removal of forms and shoring shall be in accordance with ACI 318.
- B. Exercise special care when removing forms from exposed concrete surfaces.
- C. Results of job-cured cylinders per ASTM C31 shall be used as evidence that concrete has obtained required strength to allow removal of form work.

3.03 RESHORES

- A. Construction loads exceeding the structural design loads shall not be supported upon any unshored portion of the structure.

3.04 TOLERANCES

- A. Forms shall be designed, constructed and maintained, and concrete shall be placed so as to ensure completed concrete work within the tolerance limits set forth in ACI 347R.

3.05 FIELD QUALITY CONTROL

- A. Check the lines and levels of the completed form work before concrete is placed, and make whatever corrections or adjustments to the form work necessary to correct deviations from the specified tolerances.
- B. Check form work during the placement of the concrete to ensure that the forms, shores, tie rods and clamps have not been moved from the established line, level and cross section by concrete pouring methods and equipment.

SECTION 03200 – CONCRETE REINFORCEMENT**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Steel reinforcing bars.
- B. Welded wire fabric.
- C. Accessories.

1.02 RELATED SECTIONS

- A. Section 03100- Concrete Form work.
- B. Section 03300 - Cast-In-Place Concrete.
- C. Section 04200 - Unit Masonry: For reinforcing in masonry walls.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Shop Drawings: Fabrication and placing drawings for reinforcing steel, conforming with the ACI SP-66. Include bar bending diagrams and construction joint locations.

1.04 QUALITY ASSURANCE

- A. The reinforcement work shall conform with the following except when in conflict with the building code in force; in such event the building code will govern.
 - 1. Specifications for Structural Concrete for Buildings, ACI 301.
 - 2. Details and Detailing of Concrete Reinforcement, ACI 315.
 - 3. Building Code Requirements for Reinforced Concrete, ACI 318.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Properly label bars with weatherproof tags to facilitate identification.
- B. Store reinforcing steel on supports above ground level. Keep covered with tarpaulins if there is a delay in use. Immediately remove damaged and otherwise unsuitable material, when so determined, from the site.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. New-Billet Steel Bars: ASTM A615, Grade 60, unless otherwise shown.
 - 1. Comply with ACI 301, Article 5.6.1 and CRSI MSP 1, Chapter 7 for fabrication tolerances. Shop fabricate reinforcing bars using a bending procedure which does not damage steel.

- B. Accessories: Provide bar supports and other accessories necessary to hold bars in proper position while concrete is being placed.
- C. If indicated in the drawings welded wire fabric (WWF) can be used for concrete flatwork reinforcing, with 6" laps, unless the drawings call for bar type or heavier reinforcing. The welded wire fabric shall comply with ASTM A1064. Where shown on Drawings, Fibrous concrete reinforcement may be substituted for welded wire fabric. Fibrous concrete reinforcement shall be provided by Fibermesh Company. Use only Fibermesh (MD) with only 100% virgin polypropylene fibrillated fibers containing no reprocessed olefin materials where the concrete is tested in accordance with ASTM C-94 and C-1116.
- D. Smooth dowell bars: ASTM A36

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean reinforcement to remove loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.

3.02 INSTALLATION

- A. Place reinforcement according to the approved placement drawings. Use sufficient bar supports, ties, anchors and other accessories to hold bars securely in place.
 - 1. Splice reinforcing bars only where indicated on the Drawings and per the Lap splice Schedule as noted in the drawings.
 - 2. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2" beyond the last leg of continuous bar supports. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
 - 3. Where chairs and other accessories are in contact with the form work of exposed concrete, they shall be stainless steel legged, or plastic tipped unless otherwise approved by the Engineer.
- B. Fiber reinforcement shall be added to concrete mix at the time of batching in the amounts of 1 1/2 pounds for cu. ft. of concrete.
- C. Field Adjustments: Adjust bar locations to avoid interference with inserts, sleeves and other reinforcing. When adjustment exceeds 25 percent of spacing within the plane or 1 (one) bar diameter perpendicular to the plane of the reinforcing, the layout shall be reviewed by the Structural Engineer.
 - 1. No bars shall be placed while concrete is being poured.
 - 2. No bars shall be bent after being partially embedded in hardened concrete.
- D. Coordinate and cooperate with other trades to ensure that reinforcing is in proper place and that pipes, sleeves, conduit, anchors, bolts, flashings, caulking grooves, slips and other inserts of other trades to be cast into concrete are securely placed before concrete is placed.

3.03 TOLERANCES

- A. Reinforcing shall be protected by the following minimum thicknesses of concrete, unless otherwise indicated on the Drawings:

Minimum

Cover (In.)

1. Concrete cast against and permanently exposed to earth: 3
2. Concrete exposed to weather
 - a. No. 5 bar or smaller, W31 or D31 wire and smaller: 1-1/2
 - b. No. 6 bar and larger: 2

SECTION 03300 – CAST-IN-PLACE CONCRETE**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

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

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Piers
 - 5. Equipment pads and bases.
- B. Related Sections include the following:
 - 1. Division Section 07210 "Building Thermal Insulation" for perimeter insulation under slabs-on-grade and for perimeter wall insulation (supporting backfill).

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated.
- B. Design Mixtures (if requested by Owner): For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Welding certificates (if requested by Owner).
- D. Qualification Data (if requested by Owner): For Installer and testing agency.
- E. Material Test Reports (if requested by Owner): For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- F. Material Certificates (if requested by Owner): For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement. (If shown on Drawings.)
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.

- G. Field quality-control test and inspection reports (if requested by Owner).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 2. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 3. ACI 318, "Building Code Requirements for Structural Concrete."
- F. Concrete: Comply with Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
 - 1. Materials and mixes to perform quality control testing where required by Project Manager in accordance with General Conditions.
 - 2. Provide the services of a testing laboratory to design concrete mixes.
 - 3. Testing agency shall meet the requirements of ASTM E329.
 - 4. Selection of a testing laboratory is subject to the Project Manager's acceptance.
 - 5. Submit a written description of the proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities and equipment, and other information as may be requested by the Project Manager.
- H. Tests for Concrete Materials:
 - 1. For normal weight concrete, test aggregates by the methods of sampling and testing of ASTM C33.
 - 2. For Portland Cement, sample the cement and determine the properties by the methods of test of ASTM C150.
 - 3. Submit written reports for each material sampled and tested, prior to the start of Work. Provide the Project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not materials are acceptable for intended use.
- J. Certificates of material properties and compliances with specified requirements must be submitted. Certificates of Compliance for proposed batch ingredients and admixtures must be signed by the materials producer and are to be submitted in the submittal.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

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

2.1 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C 330, 1/2-inch nominal maximum aggregate size.
- E. Water: ASTM C 94 and potable.

2.2 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.
 - 1. Products:
 - a. Euclid Chemical Company; Eucon CIA.
 - b. Grace Construction Products, W. R. Grace & Co.; DCI.
 - c. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 - 1. Products:
 - a. Cortec Corporation; MCI 2005NS.

- b. Grace Construction Products, W. R. Grace & Co.; DCI-S.
- c. Sika Corporation; FerroGard-901.

2.3 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 3/4 inches long.
 - 1. Products:
 - a. Fibrillated Fibers:
 - 1) SI Concrete Systems; Fibermesh.

2.4 WATER PROOFING MEMBRANE

- A. Refer to Division 07, Sections 07132 and 07133.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products:
 - a. ChemMasters; Spray-Film.
 - b. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - c. Dayton Superior Corporation; Sure Film.
 - d. Euclid Chemical Company; Eucobar.
 - e. L&M Construction Chemicals, Inc.; E-Con.
 - f. Meadows, W. R., Inc.; Sealtight Evapre.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Products:
 - a. ChemMasters; Safe-Cure Clear.
 - b. Conspec Marketing & Manufacturing Co., a Dayton Superior Company; W.B. Resin Cure.
 - c. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - d. Euclid Chemical Company; Kurez DR VOX.
 - e. L&M Construction Chemicals, Inc.; L&M Cure R.
 - f. Meadows, W. R., Inc.; 1100 Clear.
 - g. Tamms Industries, Inc.; Horncure WB 30.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336-inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 - 5. Air-Entrainment – Per ASTM C260.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Refer to structural drawings and specs in construction documents.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 EXECUTION

3.0 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

3.1 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated, or a maximum of 20 feet. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.2 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Comply with ACI304, "Guide For Measuring, Mixing, Transporting and Placing Concrete," and as specified.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Owner's Representative
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed-water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.3 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching

adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

- D. Rubbed Finish: After removal of forms, carefully remove all concrete fins and laitance; rub smooth with Carborundum brick. In general, one rubbing with coarse stone should be sufficient for working uneven patched surface. Final rubbing with fine stone, if required, shall be after curing and immediately before cleaning. Removal of curing compound with mineral spirits may be required. All exposed concrete surfaces shall be cleaned as follows: Mix one part white Portland cement and 1 1/2 parts sand with water, to consistency of thick paint. Thoroughly wet surfaces and brush on grout uniformly, completely filling air bubbles and holes. Immediately flatten and vigorously scour with wood float. Finish and remove excess grout with sponge rubber float as soon as grout is stiff enough so as not to be pulled from holes and depressions. When thoroughly dry, remove visible dried grout film by vigorously rubbing with burlap. Entire cleaning operation for any area shall be completed the day it is started. The final finish shall be uniform in color and monolithic in appearance.

3.4 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
 - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings
- C. Trowel Finish: Interior slabs only. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner's Representative before application.

3.5 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.6 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.7 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.8 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Owner. Remove and replace concrete that cannot be repaired and patched to Owner's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalling, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Owner's representative.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as

- original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
 - E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
 - F. Repair materials and installation not specified above may be used, subject to Owner's representative approval.

3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of three standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of three standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

- a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Owner's representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's representative but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner's representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Owner's representative
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate that they do not comply with the Contract Documents. The corrections and any other work affected by or resulting from corrections to the concrete work shall be at the Contractor's expense.

SECTION 03923 – WATER SOLUBLE SEALER / DENSIFIER**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Application of water soluble. Inorganic hardening, sealing and dustproofing product for treatment of uncovered concrete floor surfaces.
- B. Related Sections:
 - 1. Section 03300 Cast-In-Place Concrete.

1.2 REFERENCES

- A. Corps of Engineers Specification: CEGS 03300 4-79
- B. ACI 308: Standard Specification for Curing Concrete

1.3 SUBMITTALS

- A. Comply with Section 01340 Shop Drawings, Product Data and Samples
- B. Product Data: Submit manufacturer's technical bulletins and MSDS on each product.
- C. Quality Control Submittals:
 - 1. Provide protection plan of surrounding areas and non-cementitious surfaces.

1.4 QUALITY ASSURANCE

- A. Comply with Section 01410 Inspection, Sampling and Testing Laboratory Services
- B. Qualifications:
 - 1. Applicator: Experience in application of similar systems and products on projects of similar size and scope.
 - a. Successful completion of a minimum of 3 projects of similar size and complexity to specified Work.
 - b. Manufacturer Qualifications: Company shall be ISO 9001:2000 Certified.
 - c. Manufacturer: Minimum 15 years of experience in manufacturing of surface hardener.
 - d. A mock up or test installation is recommended.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01610 Delivery, Storage and Handling
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
 - 1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 2. Store tightly sealed materials off ground and away from moisture, direct sunlight, extreme heat, and freezing temperatures.
 - 3. Store in unopened packaging in clean, dry environment protected from sunlight at 40 degrees F (4 degrees C) to 85 degrees F (29 degrees C). Prevent material from freezing.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Ensure that substrate surface and ambient air temperature are minimum of 35 degrees F (minus 7 degrees C) and rising at application time and remain above 35 degrees F (minus 7 degrees C) for at least 24 hours after application. Ensure that frost or frozen surfaces are thawed and dry.
 - 2. Do not place surface hardener in areas without roof cover.

3. Allow surfaces to attain temperature and conditions specified before proceeding with surface hardener application.
4. Perform Work of this Section in well-ventilated areas.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from the following manufacturer:
Sika Corporation
201 Polito Avenue
Lyndhurst, NJ 07071
Phone: 800-933-7452
Fax: 201-933-6225
Website: www.sika.com
- B. Substitutions: Comply with Section 01610 Delivery, Storage and Handling
 1. Specifications and Drawings are based on manufacturer's proprietary literature from Sika Corporation. Other manufacturers shall comply with minimum levels of material, color selection, and detailing indicated in Specifications or on Drawings. Architect will be sole judge of appropriateness of substitutions.

2.2 MATERIALS

- A. Water soluble sealer/densifier, that when applied in accordance with manufacturers application recommendations will produce a dense surface resistant to abrasion, moisture, tire marking and provides added gloss to the floor finish.
 1. VOC Content: None
 2. Color: Clear.
 3. Acceptable Product: Sikagard 200 HD WB by Sika Corporation.

PART 3-EXECUTION

3.1 EXAMINATION

- A. Comply with Section 01700 Project Closeout.

3.2 SURFACE PREPARATION:

- A. New Concrete
 1. Properly finish freshly placed concrete surfaces. Surface is ready for application when it is damp but not wet and when it can no longer be marred by foot traffic.

3.3 APPLICATION

- A. Sikagard 200 HD WB is not a curing compound (film forming product), but should fully saturate the concrete surface for best results. Follow manufacturer's application recommendations. Acquire and review most current manufacturers published data. Including MSDS and warranty.
- B. NEW CONCRETE (green concrete immediate application)
 1. Apply undiluted Sikagard 200 HD WB to finished, damp concrete surface with low pressure sprayer after all surface water has evaporated and the surface will not be marred or damaged by application procedures. Keep the treated surface area wet with product for thirty (30) minutes by spraying additional product and/or brooming excess material from low areas. Do not allow dry spots to occur. Prevent any drying of surface for twenty (20)-thirty (30) minutes.
 2. As Sikagard 200 HD WB begins to penetrate and react, mist the surface lightly with clean water and brush, broom or power scrub with non-aggressive brush or pad into surface to aid penetration/reaction.

3. After thirty (30) minutes, depending on temperature and humidity, Sikagard 200 HD WB will begin to gel. Keep all treated surfaces moist and continue brushing/scrubbing action for 5-15 minutes. At this stage, the surface can be slippery. Use caution.
4. Flush the surface with water and squeegee the surface to remove excess material and all impurities present on the surface. Rinse with generous amounts of water to enhance product performance. Finish with a damp mop. Sikagard 200 HD WB is environmentally safe and may be flushed directly into drains.
5. DO NOT allow Sikagard 200 HD WB residue to dry on the surface. Any product allowed to dry on the surface may cause white residue that can be difficult to remove.

3.4 CLEANING

- A. Clean tools immediately after use with clean water.
- B. Clean up and properly dispose of debris remaining on Project site related to application.
- C. Remove temporary coverings and protection from adjacent Work areas.

END OF SECTION

SECTION 4200 – UNIT MASONRY**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Miscellaneous masonry accessories.
- B. Related Sections include the following:
 - 1. Section 04241 "Thin Brick Veneer System"
 - 2. Section 04251 "Thin Brick Veneer Support System"
 - 3. Section 07190 "Water Repellents" for water repellents applied to unit masonry assemblies.
 - 4. Section 07620 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
 - 5. Section 07900 "Joint Sealants" for sealing control and expansion joints in unit masonry.
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels, furnished under Division 05 Section "Metal Fabrications," where indicated on Drawings.
 - 2. Manufactured reglets in masonry joints for metal flashing, furnished under Division

1.03 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples: For each type and color of the following:
 - 1. Decorative concrete masonry units.
 - 2. Face brick, in the form of straps of five or more bricks.
 - 3. Special brick shapes.
 - 4. Weep holes/vents.
 - 5. Accessories embedded in masonry.
- D. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch

numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- E. Qualification Data: For testing agency.
- F. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Grout mixes. Include description of type and proportions of ingredients.
 4. Reinforcing bars.
 5. Joint reinforcement.
 6. Anchors, ties, and metal accessories.
- G. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Preconstruction Testing Service: Owner may engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
 1. Clay Masonry Unit Test: For each type of unit required, per ASTM C 67.
 2. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
 3. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
 4. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.
- E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- F. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.
 1. Build sample panels for typical exterior wall / typical interior wall in sizes approximately 48 inches long by 48 inches high.

2. Clean one-half of exposed faces of panels with masonry cleaner indicated.
3. Protect approved sample panels from the elements with weather-resistant membrane.
4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Owner in writing.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.07 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. (Latest Editions).
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. (Latest Editions.)

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Refer to drawings.
 - 2. Manufacturers: Refer to drawings.

2.02 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.03 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
 - 1. Provide special shapes for corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners, unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
 - a. Products:
 - 1) Grace Construction Products, unit of W. R. Grace & Co. - Conn.; Dry-Block.
 - 2) Owner approved equal.
- C. Concrete Masonry Units: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
 - 2. Weight Classification: Medium weight, unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Owner's furnished sample.

2.04 BRICK

- A. General: Provide shapes indicated and as follows:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216, Grade SW, Type FBX.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.

2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
5. Products:
 - a. Refer to architectural drawings for brick selection

2.05 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Masonry Cement: ASTM C 91.
- E. Mortar Cement: ASTM C 1329.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
- G. Aggregate for Mortar: ASTM C 144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
- H. Aggregate for Grout: ASTM C 404.
- I. Cold-Weather Admixture: Non-chloride, non-corrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. Products:
 - a. Addiment Incorporated; Mortar Kick.
 - b. Euclid Chemical Company; Accelguard 80.
 - c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
 - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
- J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
 1. Products:
 - a. Grace Construction Products, unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - b. Owner approved equal.
- K. Water: Potable.

2.06 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.
 1. Exterior Walls: Hot-dip galvanized, carbon steel.
 2. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
 3. Wire Size for Cross Rods: W2.8 or 0.188-inch diameter.
 4. Wire Size for Veneer Ties: W2.8 or 0.188-inch diameter.
 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 6. Provide in lengths of not less than 10 feet.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
- D. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- diameter, hot-dip galvanized, carbon-steel continuous wire.

2.07 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
 - 2. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 - 1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
 - 2. Wire: Fabricate from 3/16-inch-diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter, hot-dip galvanized steel wire.
 - 2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch diameter, hot-dip galvanized steel wire.
- E. Partition Top anchors: 0.097-inch thick metal plate with 3/8-inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins, unless otherwise indicated.
 - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153.
- G. Adjustable Masonry-Veneer Anchors
 - 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 - 2. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.
 - 3. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than 3 exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

2.08 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.

2.09 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual and Division 07 Section "Flashing and Sheet Metal" and as follows:
 - 1. Stainless Steel: ASTM A 240, Type 304, 0.016 inch thick.
 - 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
 - 3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
 - 4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 - 5. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 - 6. Fabricate through-wall flashing with sealant stop, unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
 - 7. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
- B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:
 - 1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch thick.
 - a. Products:
 - 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
 - 2) Firestone Building Products; FlashGuard.
 - 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
- C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.
 - 1. Product: Subject to compliance with requirements, provide "Blok-Flash" by Advanced Building Products Inc.
- D. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Flashing and Sheet Metal."
 - 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 - 2. Elastomeric Sealant: ASTM C 920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
 - 1. Dur-O-Wall; Rapid Soft-Joint/Expansion Joint.
 - 2. Hohmann & Barnard, Inc.; NS Series - Closed Cell Neoprene Sponge.
 - 3. Williams Products; SAS-1040 and EJS-1040.

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 - 1. Dur-O-Wall; Rapid Control Joint Rubber Compound.
 - 2. Heckmann Building Products; Rubber Control Joint.
 - 3. Hohmann & Barnard, Inc.; RS Series Rubber Control Joint.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Vinyl weep hole/vent, one-piece, offset, T-shaped units made from flexible, injection-molded PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color approved by Architect to match that of mortar.
 - 1. Hohmann & Barnard, Inc.; #343 Louvered Weep Hole.
 - 2. Williams Products, Inc.; Williams-Goodco Brick Vent.
 - 3. Wire-Bond; Louvered Weepholes.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
 - 1. Mortar Net USA, Ltd.; Mortar Net.
- F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
 - 1. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - 2. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - 3. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - 4. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.12 MASONRY CLEANERS

- A. Masonry Cleaner: For all materials and methods for cleaning masonry, follow manufacturers recommendations. Do not use muriatic acid.
- B. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2-cup dry measure) and laundry detergent (1/2-cup dry measure) dissolved in one gallon of water.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. For masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface-acting acids, chelating, and wetting agents.
 - 2. For dark-colored masonry not subject to metallic oxidation stains, use formulation consisting of a liquid blend of surface-acting acids and special inhibitors.
 - 3. For masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic and inorganic acids and special inhibitors.
 - a. Products: Subject to compliance with requirements, products that may be used to clean unit masonry surfaces include, but are not limited to, the following:
 - 1) ProSoCo, Inc.
 - 2) Diedrich Technologies, Inc.
 - 3) EaCo Chem, Inc.

2.13 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement and lime.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
 - 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
- C. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.
- D. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.03 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond, unless otherwise indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, and similar items, unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.

3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division Section 07930 "Fire-Resistive Joint Systems."

3.04 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and concrete masonry units as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.06 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, pipe enclosures, and other special conditions.

3.07 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.08 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.

2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Embed connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
6. Space anchors as indicated, but not more than 16 inches o.c. vertically and 32 inches o.c. horizontally with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.09 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement. Placement is to be in accordance with the International Masonry Institute recommendations.
- B. Form control joints in concrete masonry as follows:
 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick made from clay or shale as follows:
 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 3. Build in compressible joint fillers where indicated.
 4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division Section 07900 "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.

3.10 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated on Drawings.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
3. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
5. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
 1. Use specified weep/vent products to form weep holes.
 2. Space weep holes 24 inches o.c. at brick veneer, unless otherwise indicated.
 3. Space weep holes 32 inches o.c. at single-wythe cmu, unless otherwise indicated.
- F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.13 FIELD QUALITY CONTROL

- A. Inspectors: Owner may engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
 - 1. Payment for these services will be made by Owner.
 - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

SECTION 04241 - THIN BRICK VENEER SYSTEM**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes thin brick units and related materials
 1. Thin Brick
 2. Mortar
 3. Cleaning
 4. Embedded Flashing
 5. Weepholes/Vents
 6. Expansion Joints
- B. Related Sections
 1. 03300 Cast-In-Place Concrete Division
 2. 04200 Unit Masonry
 3. 04251 Thin Brick Veneer Support System
 4. 05500 Metal Fabrications
 5. 06100 Rough Carpentry
 6. 06160 Sheathing
 7. 07132 Pre-Applied Sheet Membrane Waterproofing
 8. 07133 Self-Adhering Sheet Waterproofing
 9. 07210 Building Thermal Insulation
 10. 07271 Air/Moisture Barrier
 11. 07620 Sheet Metal Flashing and Trim
 12. 07900 Joint Sealants

1.3 REFERENCES

- A. ASTM A 240 – Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- B. ASTM A 653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
- C. ASTM A 925 – Standard Specification for Zinc 5% Aluminum Mischmetal Alloy Coated Steel Overhead Ground Wire Strand
- D. ASTM C 67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- E. ASTM C 270 – Standard Specification for Mortar for Unit Masonry
- F. ASTM C 1088 – Standard Specification for Thin Veneer Brick Units Made From Clay or Shale
- G. ASTM C 1330 – Standard Specification for Preblended Dry Mortar Mix for Unit Masonry
- H. ASTM D 226 – Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Waterproofing
- I. ASTM D 1056 – Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
- J. TMS 602/ACI 530.1/ASCE 6 – Specifications for Masonry Structures

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations
 2. Storage and handling requirements and recommendations
 3. Installation methods

- C. Shop Drawings
 - 1. Indicate masonry sizes, layout, patterns, corbels, racking, coursing, color arrangement, perimeter conditions, shape requirements and location, junctions with dissimilar materials, connections, and other related components.
 - 2. Locate and detail expansion and control joints.
- D. Samples: Furnish not less than five individual thin brick as samples for each thin brick specified, showing extreme variations in color and texture.

1.5 QUALITY ASSURANCE

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 unless modified by requirements in the Contract Documents.
- B. Comply with all applicable codes, regulations, and standards. Where provision of applicable codes, regulations, and standards conflict with requirements of this section, the more demanding shall govern.
- C. Manufacturer Qualifications:
 - 1. Obtain materials from one manufacturer to ensure compatibility.
 - 2. Obtain materials from company specializing in manufacturing products specified in this section with a minimum 5 years documented experience.
- D. Installer Qualifications:
 - 1. Proof of a minimum of five years experience with related thin masonry installations.
 - 2. At least one supervisory journeyman who shall be present at all times during execution of work, who shall be thoroughly familiar with design requirement, type of materials being installed, reference standards and other requirements, and who shall direct all work performed at jobsite.
- E. Material Certificates: Prior to delivery, submit to Architect/Engineer certificates indicating compliance with the applicable specifications for Thin Brick Grades, Types or Classes included in these specifications.
- F. Thin Brick Test Reports: Submit test reports substantiating compliance with requirements: Sample and test in accordance with ASTM C 67.
 - 1. Testing and reports shall be completed by an independent laboratory.
 - a. Test reports for each type of thin brick shall be submitted to the Architect/Engineer for review.
 - b. Thin Brick Test reports shall indicate:
 - 1) 2-hour cold water absorption
 - 2) 5-hour boil absorption
 - 3) Saturation coefficient
 - 4) Initial rate of absorption
 - 5) Efflorescence
- G. Sample Panel: Sample or mock-up panels shall be used to review installation process as well as thin brick and mortar color and serves as the standard of workmanship for the Project.
 - 1. Build [sample] [mock-up] panel of typical wall area as shown on Drawings.
 - 2. Build Mockup panels for typical exterior wall in sizes approximately 48" (1200 mm) long by 48" (1200 mm) high by full wall thickness.
 - 3. All thin brick shipped for the sample shall be included in the panel.
 - 4. Use panel as standard of comparison for all masonry work built of same material.
 - 5. Where masonry is to match existing, erect panel adjacent and parallel to existing surface.
 - 6. Clean one-half of exposed faces of panel with masonry cleaner as indicated and approved by manufacturer.
 - 7. Protect accepted panel from the elements with weather-resistant membrane.
 - 8. Approval of panel is for color, texture, and blending of masonry units; relationship of mortar to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - 9. Do not start work until Architect/Engineer/Owner has accepted sample panel.
 - 10. Do not destroy or move panel until work is completed and accepted by Architect/Engineer/Own

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in dry location in manufacturer's unopened packaging until ready for installation.
- B. Store all materials off the ground to prevent contamination by mud, dust or other materials likely to cause staining or other defects.
- C. Protect materials from contamination, dampness, freezing, or overheating in accordance with manufacturer's instructions.
- D. Store different types of materials separately.

1.7 PROJECT CONDITIONS

- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.
- B. Protection of Work:
 - 1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by material manufacturers for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
 - 2. Stain Prevention:
 - a. Prevent grout or mortar from staining the face of masonry.
 - b. Remove immediately grout or mortar in contact with face of such masonry.
 - c. Protect all sills, ledges and projections from droppings of mortar.
 - d. Protect the wall from rain-splashed mud and mortar splatter by spreading coverings on ground and over wall surface.
 - e. Turn scaffold boards closest to the wall on edge when work is not in progress to prevent rain from splashing mortar and dirt onto masonry.
- C. Cold Weather Requirements:
 - 1. Do not use frozen materials or materials mixed or coated with ice or frost.
 - 2. Do not build on frozen substrates.
 - 3. Remove and replace unit masonry damaged by frost or by freezing conditions.
 - 4. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- D. Hot Weather Requirements:
 - 1. Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 2. Protect mortar from uneven and excessive evaporation.
 - 3. The face of the installed thin brick may be dampened with water prior mortar installation to reduce the absorption of moisture from the mortar joint and increase bond.
 - 4. Veneer may be fogged with water to allow the mortar enough time to set. Apply only enough moisture to consistently dampen the wall without allowing water to run down the face.

PART 2 PRODUCTS**2.1 MASONRY UNITS, GENERAL**

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not install units where such defects will be exposed in the completed work.

2.2 MANUFACTURERS

- A. Acceptable Manufacturer: Glen-Gery Corporation located at 1166 Spring Street • P.O. Box 7001, Wyomissing, PA 19610 Tel: 610-562-3076 • Web: www.glengery.com
- B. Substitutions: Or approved equal.

2.3 CLAY MASONRY UNITS

- A. General: Provide shapes indicated and as follows:

1. Provide special shapes for applications where flats (stretcher units) cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, shelf angles and lintels. Mitered units shall not be used at standard corners.
 2. Provide special shapes for applications requiring thin brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 3. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. All Thin Brick specified and shown on drawings shall be Glen-Gery Modular Thin Brick as manufactured by the Glen-Gery Corporation.
1. Thin Brick: ASTM C 1088, Grade Exterior
 - a. Type TBX
 - b. Modular Size: 2-1/4" (57.2 mm) high, 7-5/8" (193.7 mm) long unless noted otherwise in drawings.
 - c. Thickness: 3/4" (19 mm) unless noted otherwise in drawings.
- C. Provide thin brick similar in texture, color and physical properties to those available for inspection at the Architect/Engineer's office and/or as supplied on the approved sample panel.

2.4 MORTAR

- A. Refer to Section 04251 Thin Brick Support System

3.2 FLASHING

- A. Refer to Section 04251 Thin Brick Support System

2.5 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by manufacturer of masonry units being cleaned.
1. Contact a Glen-Gery representative to determine cleaning solution and procedure for thin brick specified. Verify acceptability of cleaner for cleaning masonry with pigmented mortar joints. Delete solution(s) not recommended.
 - a. Diedrich Technologies, Inc.
 - b. 202 New Masonry Detergent
 - c. 202V Vana-Stop®
 - d. Other as recommended by masonry unit and mortar manufacturer.

2.6 RELATED MATERIALS

- A. Embedded Flashing Materials
1. Refer to Section 04251 Thin Brick Support System
- B. Flexible Flashing:
1. Refer to Section 04251 Thin Brick Support System
- C. Expansion Joints
1. Refer to Section 04251 Thin Brick Support System
- D. Weather Barriers:
1. Refer to Section 07271 Air / Moisture Barrier

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates and foundations as well as rough-in and built-in construction have been properly prepared.

- B. Walls must be structurally sound and the substrate system designed with a wall deflection not greater than $L/360$.
- C. Verify substrate including, concrete, masonry or framing as well as sheathings, water resistant barriers are properly installed.
- D. If substrate, foundations or flashings are the responsibility of another installer, notify Architect and General contractor of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. All surfaces must be free of water, snow, dirt, mud, oil and other foreign materials prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Trim or flash in place per manufacturer's details and/or BIA Technical Note 7A on flashing of Brick Walls.

3.3 INSTALLATION

- A. Install Glen-Gery Thin Brick in accordance with manufacturers written installation instructions.
- B. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement joints, returns, and offsets.
 - 1. Avoid using less-than-half-size units, particularly at corners and jambs.
 - 2. Ensure unfinished or cut faces are not exposed to view upon completion.
- C. Select and arrange exposed masonry units to produce a uniform blend of color and texture.
 - 1. Mix units from several pallets or cubes as they are placed.
- D. Lay masonry in bond pattern as indicated on drawings or general notes.
- E. Comply with tolerances in TMS 602/ACI 530.1/ASCE 6.

3.4 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove adhesive as well as mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Cut out all defective mortar joints and holes in exposed masonry and provide new mortar.
 - 2. Clean preselected sample wall area with specified cleaning solution as per manufacturer's recommendations. Do not proceed with cleaning until approved by Architect.
 - 3. Clean thin brick in accordance with manufacturer's written instructions.
 - 4. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 5. All cleaning practices and product used shall be in accordance with cleaning products manufacturer's written instructions.

SECTION 04251 – BRICK VENEER SUPPORT SYSTEM**PART 1- GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Thin Tech® Thin Masonry Support System comprised of:
 - a. Thin Tech® Thin Masonry Support Panel
 - b. Glen-Gery Construction Adhesive
 - c. Silicone Adhesive and Primer
 - d. Thin Tech® Air Vent
 - e. Thin Tech® Starter Angle
 - f. Thin Tech® Shim
 - g. Thin Tech® Universal Corner Support
 - h. Thin Tech® Fasteners
 - i. Thin Tech® spacers
 - j. Transition Tape
 - k. Glen-Gery Mortar
 - 1) Color Mortar Blend (Portland cement lime mortar)
 - 2) Type N or Type S Preblended Mortar
 - 2. Related Materials and Procedures:
 - a. Thin Brick
 - b. Cleaning
 - c. Embedded Flashing
 - d. Weepholes/Vents
 - e. Movement Joints
 - f. Fasteners
 - g. Silicone Sealant
 - h. Silicone Sealant Primer
- B. Related Sections:
 - 1. Division 03 Section 03300 Cast-In-Place Concrete
 - 2. Division 04 Section 04200 Unit Masonry
 - 3. Division 06 Section 06100 Rough Carpentry
 - 4. Division 07 Section 07132 Pre-Applied Sheet Membrane Waterproofing
 - 5. Division 07 Section 07133 Self-Adhering Sheet Waterproofing
 - 6. Division 07 Section 07210 Building Thermal Insulation
 - 7. Division 07 Section 07271 Air/Moisture Barrier
 - 8. Division 09 Section 09250 Gypsum Wallboard

1.3 REFERENCES

- A. ANSI A118.4 - American National Standards Institute Specifications for Modified Dry-Set Cement Mortar
- B. ANSI A118.15 – American National Standards Institute Specifications for Improved Modified Dry-Set Cement Mortar
- C. ASTM A 240 – Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- D. ASTM A 510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
- E. ASTM A 653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc

- Iron Alloy Coated (Galvannealed) by the Hot Dip Process
- F. ASTM A 925 – Standard Specification for Zinc 5% Aluminum Mischmetal Alloy Coated Steel Overhead Ground Wire Strand
 - G. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
 - H. ASTM C 67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
 - I. ASTM C 126 – Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
 - J. ASTM C 270 – Standard Specification for Mortar for Unit Masonry
 - K. ASTM C 954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
 - L. ASTM C 1088 – Standard Specification for Thin Veneer Brick Units Made From Clay or Shale
 - M. ASTM C 1364 - Standard Specification for Architectural Cast Stone
 - N. ASTM C 1405 – Standard Specification for Glazed Brick (Single Fired, Brick Units)
 - O. ASTM E 2925 - Standard Specification for Manufactured Polymeric Drainage and Ventilation Materials Used to Provide a Rainscreen Function
 - P. ASTM D 4716 – Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
 - Q. ASTM E 2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights
 - R. TMS 602 (ACI 530.1/ASCE 6) – Specifications for Masonry Structures.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product description, indicating material types and thicknesses and storage and handling requirements.
- B. Samples: Submit samples of each product type proposed for use.
- C. Material Certificates: Prior to delivery, submit to Architect/Engineer certificates indicating compliance with the applicable codes, specifications and criteria herein for Thin Brick, including Grade and Type listed in this Section.
- D. Thin Brick Test Reports: Submit test reports substantiating compliance with requirements of ASTM C1088. Sample and test in accordance with ASTM C 67.
 - 1. Testing and reports shall be completed by an independent laboratory.
 - a. Test reports for each type of brick shall be submitted to the Architect/Engineer for review.
 - b. Thin Brick Test reports shall indicate:
 - 1) 5-hour boiling water absorption
 - 2) Saturation coefficient
 - 3) Initial rate of absorption
 - 4) Efflorescence Rating
- E. Costs of Tests: Cost of tests shall be borne by the purchaser, unless tests indicate that units do not conform to the requirements of the specifications, in which case cost shall be borne by the seller.
- F. Installation Instructions: Submit copy of manufacturer's product installation instructions
- G. Manufacturer's Details: Submit individual drawings to be approved by Architect for special shaped thin veneer units.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty Documentation:
 - 1. Product warranty documentation specified under Section 3.12 shall be supplied to contractor (for subsequent provision to building owner) upon completion of building construction.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Maintenance:
 - 1. Installer shall supply to contractor (for subsequent provision to building owner) copy of manufacturer's pertinent documentation relating to typical repair of thin veneer system once occupancy commences.

1.7 QUALITY ASSURANCE

- A. Masonry Standard: Comply with TMS 602 (ACI 530.1/ASCE 6) unless modified by requirements in the Contract Documents.
- B. Comply with all applicable codes, regulations, and standards. Where provisions of applicable codes, regulations and standards conflict with requirements of this section, the more demanding shall govern.
- C. Manufacturer Qualifications:
 - 1. Obtain materials from one manufacturer to ensure compatibility.
 - 2. Thin Masonry Support Panel:
 - a. Documented qualifications and capabilities that fully describe the ability to provide the required metal panel system and technical support to the Owner.
 - b. At least five (5) completed projects over the last two years, illustrating system performance equal to or exceeding the criteria listed in this specification.
 - 1) Include the project location, award date, the completion date, the contract value, and the name and telephone number of a person employed by the Owner who has personal knowledge of the manufacturer's contractual and technical performance.
- D. Installer Qualifications:
 - 1. All products listed in this Section shall be installed by a Glen-Gery trained Thin Tech[®] installer or installer providing proof of a minimum of five years' experience with a related thin masonry support system.
 - 2. At least one supervisory journeyman, who has completed Glen-Gery Thin Tech[®] training, shall be present at all times during execution of work, who shall be thoroughly familiar with design requirements, types of materials being installed, reference standards and other requirements, and who shall direct all Thin Tech[®] related work performed at jobsite.
 - 3. Upon request, installer shall furnish proof of training/experience documentation that may include the following to Contractor prior to commencement of work under this Section:
 - a. Glen-Gery training certificate.
 - b. Lists of completed projects with project names, addresses, and contact information of architects and owners.
 - c. Specialty certification held by installer that are relevant to this project, including the name of the certification, certifying body, and date certified.
- E. Sample/ Mock-Up Panels: Sample/mock-up panels shall be used to review installation process as well as thin brick, and mortar color selections and serves as the standard of workmanship for the Project.
 - 1. Build Mock-up panels with adjoining walls at a 90 degree for Thin Tech[®] System in sizes approximately 48 in. (1,219 mm) long by 48 in. (1,219 mm) high by full wall thickness.
 - 2. Build mock-up panel for walls to receive Glen-Gery Thin Tech[®] System as shown on designated project drawings.
 - a. All thin brick shipped for the mock-up shall be included in the panel.
 - b. Use mock-up panel as standard of comparison for all masonry work built of same material.
 - c. Where masonry is to match existing, erect panel adjacent and parallel to existing surface.
 - d. Clean one-half of exposed faces of panel with masonry cleaner as indicated and

- approved by brick manufacturer.
- e. Approval of panel is for color, texture, and blending of masonry units; relationship of mortar to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
- f. Protect approved panel from the elements.
- g. Do not start work until Owner has accepted mock-up panel.
- h. Do not destroy or move sample or mock-up panels until work is completed and accepted by Owner.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's unopened packaging.
- B. Inspect all materials upon arrival and notify supplier if any damage is observed. Store products in manufacturer's packaging or according to manufacturer's recommendations until ready for installation.
- C. Store Glen-Gery Thin Tech[®] Panels, masonry units, mortar, and accessories off the ground to prevent contamination by mud, dust or other materials likely to cause staining or other defects.
- D. Protect materials from contamination, moisture, freezing, overheating or other damage in accordance with manufacturer's instructions. Cover all materials with a non-staining waterproof membrane material when necessary to protect from elements.
- E. Store different types of materials separately.
- F. Store adhesive and mortar additive above 32° Fahrenheit and below 86° Fahrenheit temperatures.
- G. Store and dispose of solvent-based materials and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- H. Panels must be stored to prevent permanent distortion and kept dry before installation. Panels and
- I. accessories should be covered at all times prior to installation.
- J. Dry panels exposed to water or condensation prior to installation or application of thin brick. The presence of moisture on the brick or metal panels may adversely affect adhesive performance.

1.9 PROJECT CONDITIONS

- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during and after installation.
- B. Protection of Work:
 - 1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's limits.
 - 2. Stain Prevention:
 - a. Prevent adhesive and mortar from staining the face of masonry.
 - b. To avoid smearing of adhesive or mortar on the face of masonry, allow adhesive and mortar on face of installed masonry to become firm before trying to remove.
 - c. Protect all sills, ledges and projections from droppings of adhesive or mortar.
 - d. Protect the wall from rain-splashed mud and mortar splatter.
- C. Cold Weather Requirements:
 - 1. Do not use frozen masonry materials or materials mixed or coated with ice or frost.
 - 2. Do not build on frozen substrates.
 - 3. Comply with cold-weather construction requirements contained in TMS 602 (ACI 530.1/ASCE 6).
- D. Hot Weather Requirements:
 - 1. Comply with hot-weather construction requirements contained in TMS 602 (ACI 530.1/ASCE 6).

2. Protect mortar from uneven and excessive evaporation.
 - a. The face of the installed thin brick may be dampened with water prior to mortar installation to reduce the absorption of moisture from the mortar joint and increase bond.
 - b. Veneer may be fogged with water to prevent drying prior to proper hydration of mortar. Apply only enough moisture to consistently dampen the wall without allowing water to run down the face of the masonry

PART 2- PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturer: Glen-Gery Corporation located at 1166 Spring Street, P.O. Box 7001, Wyomissing,
- B. PA 19610; Tel: 610-562-3076; Email: info@glengery.com; Web: www.glengery.com
- C. Substitutions: Not permitted.

2.2 THIN MASONRY VENEER SUPPORT SYSTEM

- A. Thin Masonry Veneer Support Panel: Metal support panel consisting of 26 gauge (16 mil), stucco embossed, textured steel with angled ties providing structural mechanical support for interior or exterior thin masonry veneer, installed by fastening to concrete, masonry, metal or wood frame construction.
 1. All Metal Panels for thin brick support specified and shown on drawings shall be Elite Thin Tech® Panels as manufactured by the Glen-Gery Corporation.
 2. Exterior Finish: G90 Galvanized with thermal set coating.
 3. Support ties: 3/8 in. (10 mm).
 4. Support Panels: 4 ft. x 4 ft. nominal (16 sq. ft, 1.44 m² - actual dimensions except as noted: 48 in. [W] 47-7/8 in. x [H] 48 in. x [T] 3/8 in. {1,216 mm x 1,219 mm x 10 mm}) masonry support panels for flat wall areas, shall be for unit heights as follows:
 - a. 2-5/8 in. (2.667 in., 68 mm) spacing for Modular, Standard, Norman, and other 2-1/4 in. (57 mm) high units. Three (3) courses equal 8 in. (203 mm).
- B. Fasteners (For Masonry Support Panel)
 1. Screw fasteners as supplied by Glen-Gery: Pan head fasteners with a minimum #10, (0.190 in., 4.8 mm) thread diameter and corrosion resistance provided by tri-layered ceramic surface coating with a minimum protection of 1000 hrs. when tested according to ASTM B117.
 - a. Fasteners for attachment to wood studs, concrete and masonry: Self-tapping, point type 17.
 - b. Fasteners for attachment to light gauge steel studs: Self-drilling, with a drilling capacity of 0.035 to 0.176 in. and minimum torsional strength of 75 lb/in.
 2. Fastener Length:
 - a. Wood stud fasteners: 5-1/4 in. (133 mm) Screw fasteners shall penetrate the studs a minimum of 1-1/4 in. (32 mm).
- C. Starter Angle Flashing:
 1. Glen-Gery Thin Tech® Starter Angle:
 - a. Stainless steel conforming to ASTM A240/A240M, Type 304, 0.018 in. (0.45 mm) (26 gauge) pre-bent in 10 ft. (3.05 m) lengths.
 - b. Depth: 4-1/4 in. (108 mm)
 - c. Profile: 45 degree drip
- D. Water-Resistive Barrier
 1. Provide Air / Moisture Barrier as designated in Section 07271
- E. Shims: 2-5/8 in. (67 mm) wide by [H] 48 in. (1,219 mm) by [T] 3/8 in. (10 mm), manufactured from G90 hot dipped galvanized, 26 gauge (16 mil) steel with thermal set coating, stucco embossed texture and centered channel.
- F. Adhesives and Primer

1. Glen-Gery Heavy Duty Construction Adhesive for thin brick (maximum 1 in. [25 mm] thick) as supplied by Glen-Gery:
 - a. High-strength mastic exceeding ASTM D3498 and ASTM C557 specifications with less than 70 grams of VOC per liter with a shear value between the thin veneer and the panel greater than 50 PSI (10.5 kg/cm²).
2. Adhesive for thin brick units more than ¾ in. (19 mm) thick and thin brick units 3-⅝ in. (92 mm) when not otherwise mechanically attached (e.g. with Glen-Gery Thin Tech® support channels or clips) as supplied by Glen-Gery:
 - a. Silicone meeting or exceeding the following: TT-S-00230C, Class A, ASTM C-920, Class 50, Type S, Grade NS, Use G,A,M,O; Type I & II, ASTM C1184-05, AAMA 805.2, AAMA 802.3 & 808.3, ASTM C1248.
- G. Installation Hardware
 1. Support Channels: 8 ft. (2.44 m) long, manufactured from 26 gauge (18 mil) [stainless steel] with ½ in. (13 mm) support leg, ¾ in. (19 mm) wide by ½ in. (13 mm) high clip
 - a. 3-¾ in. (95 mm) Type 1 Classic Channel for 3-⅝ in. (92 mm) high units
- H. Universal Corner Support: 6 in. (152 mm) x 6 in. (152 mm) x 4 ft. (1.22 m) long, pre-bent 90 degrees, manufactured from 26 gauge (16 mil) , stucco embossed, textured steel
 1. Exterior Finish: G90 Galvanized with thermal set coating
- I. Thin Tech® Spacer: 1-1/4" in. (31 mm) [H] x 1 in. (25 mm) [W] x 3/4 in. (19 mm) [T] injection molded plastic with height-setting panel clip, reusable.
- J. Weepholes/Vents:
 1. Glen-Gery Thin Tech® Air Vent: Impact resistant polypropylene copolymer. Density 2,000 grams/sq. meter. Size: ⅜ in. (10 mm) x ½ in. (13 mm) x 48 in. (1.22 m).

2.3 MASONRY UNITS, GENERAL

- A. Masonry unit weight may not exceed 15 psf.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other imperfections exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed work.

2.4 MORTAR

- A. Cold Weather Additives (including accelerators) shall not be used in mortar.
- B. Mortar for thin brick:
 1. Mortar shall conform to ASTM C 270, Standard Specification for Mortar for Unit Masonry.
 - a. Refer to building elevations - Type N
 2. Mortar modified with polymer additives and conforming to ANSI A118.4 or ANSI A118.15 specifications for modified or improved modified dry-set cement mortar.

2.5 ANCILLARY MATERIALS

- A. Flashing
 1. Stainless Steel Fabric Flashing: Composite flashing product consisting of a 0.003 in. (0.08 mm) single sheet of Type 304 stainless steel bonded to a 0.004 in. (0.10 mm) layer of polymeric fabric with a butyl block co-polymer adhesive.
 2. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:
 - a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 in. (1.0 mm) thick.
 - b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 in. (0.6 mm) thick, with a 0.015 in. (0.4 mm) thick non-asphaltic adhesive.
 3. Butyl Flashing: Self-adhering flashing membrane, minimum 0.016 in. in thickness (0.15 mm) consisting of a polyolefin film and butyl adhesive
 4. Adhesives, Primers, and Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for joints or connections

to or between water- resistive barrier or air barrier system components.

- a. Transition Tape:
 - 2) Asphalt free self-adhering membrane, 3 in. (76 mm) wide, consisting of woven polyethylene/polypropylene film bonded to heavy duty synthetic rubber adhesive.
 - 3) Self-adhering tape, 3 in. (76 mm) wide, consisting of a polyolefin film with an acrylic adhesive.
 - b. Primer: As recommended by the manufacturer of the specified product
- B. Control and Expansion Joints
- 1. Backer Rod: Non-gassing polyethylene or flexible polyurethane foam rod 25% wider than width of joint to be filled and depth exceeds requirements in as indicated in Division 07 Section "Joint Sealants".
 - 2. Sealant: As specified in Division 07 Section "Joint Sealants" and complying with ASTM C920.

2.6 RIGID INSULATION

- A. Provide rigid insulation as designated in Division 07 and as noted in drawings.
- B. Closed-cell insulating rigid foam shall have a minimum compressive strength of 15 pounds per square inch and comply with the requirements of ASTM C578
- C. Maximum flame spread and smoke development when tested in accordance with ASTM E 84 shall not exceed 25 and 450 respectively.
- D. Thickness as noted in drawings and shall not exceed 3 in (76mm).

2.7 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Diedrich Technologies, Inc.
 - a. 202 New Masonry Detergent
 - b. 202V Vana-Stop®
 - c. Green Clean 250 Manufactured Stone Cleaner

PART 3- EXECUTION

3.1 EXAMINATION

- A. Do not begin Thin Tech® installation until substrates, water-resistive barrier, drainage mat, foundations, rough-ins and built-in construction have been installed according to project specifications and building code requirements.
 - 1. Walls must be structurally sound and the substrate system designed with a wall deflection not greater than L/360.
 - a. Maximum wall frame spacing for stud walls = 24 in. (610 mm) O.C.
 - b. Maximum wall frame spacing for girts = 24 in. (610 mm) O.C.
 - c. Minimum 0.043 in. (18 gauge; 1.09 mm) metal framing for exterior walls.
 - 2. Substrate shall provide continuous support and be flat, with surface variation not exceeding 1/8 in. (3 mm) within any 4 ft. (1.2 m) square area and have no planar irregularities greater than 1/4 in. (6 mm) in 10 ft. (3.05 m).
 - 3. Substrate shall be concrete, masonry or one of the following as deemed suitable for specific project conditions:
 - a. Closed-cell insulating rigid foam not less than 1/2 in. (13 mm) thick conforming to ASTM C578 (min. 15 psi compressive strength and minimum 1.30 lb./cu. ft. [21 kg/cu. m] density) or ASTM C1289.
 - b. Oriented strand board (OSB) not less than 7/16 in. (11 mm) in thickness.

- c. Exterior grade plywood not less than 3/8 in. (10 mm) in thickness.
- B. Verify walls are plumb and corners are braced to specifications.
- C. If substrate (including insulation), water-resistive barrier, drainage mat, foundations or flashings (including roof and kickout flashing when applicable) are the responsibility of another installer, notify Architect and General Contractor of unsatisfactory preparation before proceeding.
- D. Do not begin installation of Thin Tech panels until unacceptable conditions have been corrected. Installation constitutes acceptance of existing conditions.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. All surfaces including, but not limited to metal panel and back face of thin brick must be free of water, snow, dirt, mud, oil and other foreign materials prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Trim or flash in place per manufacturer's details and/or BIA *Technical Note* 28C on Thin Brick Veneer.
- D. Protect the tops of all uncompleted walls to prevent water entry.

3.3 INSTALLATION, GENERAL

- A. Install materials in accordance with manufacturer's instructions.
- B. Select and arrange exposed masonry units to produce a uniform blend of color and texture.
 - 1. Install masonry units from several pallets or cubes as they are placed.
- C. Comply with tolerance requirements in TMS 602 (ACI 530.1/ASCE 6).

3.4 FLASHING

- A. Prior to metal panel installation, install starter angle and flashing in accordance with Glen-Gery Thin Tech® installation instructions or ASTM E2112. Prime substrate prior to installation when required by flashing manufacturer.
- B. Seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
- C. Extend horizontal through wall flashing vertically up the backing a minimum of 3 in. (76 mm).
- D. Lap flashing ends a minimum of 3 in. (76 mm).
- E. Seal vertical and horizontal legs of all flashing laps with compatible lap sealant.
- F. Lap water-resistive barrier over top of flashing.
- G. Turn up the ends of discontinuous (e.g., head, sill and stepped) flashings to form end dams or extend not less than 4" (102 mm) beyond edges of openings.
- H. Extend flashing through wall with at least 1/4 in. (6 mm) exposed to form a drip.

3.5 THIN MASONRY SUPPORT PANEL

- A. Install in accordance with manufacturer's written instructions as applicable to each type of substrate required.
- B. Trim, starter angle and flashing shall be installed prior to panel installation.
- C. Panels shall be clean, dry and free of dirt, oil or any other foreign contaminant.
- D. Attach panels flat to the substrate in true and level rows with support ties aligned and level to each other, including at corners.
- E. Stagger vertical support panel joints over sheathing joints and at least 16 in. (406 mm) horizontally from panels in rows above or below.
- F. Install full-size uncut panels when possible. Cut panels using a method resulting in clean,

unbent edges when necessary to provide vertical staggered panel joints, to ensure panels are fastened to studs, or to fit specific conditions.

- G. Install panels with 1/16 in. to 1/8 in. (2 to 3 mm) space between the vertical edges of panels.
- H. Do not allow panels to bridge vertical or horizontal movement joints in substrate. The space between metal panels at substrate movement joint locations shall be equal to the thickness of the substrate movement joint.
- I. Stop panel at least 3/8 in. (10 mm) from inside corners, openings and other materials to allow for movement.
- J. Start panels at least 4 in. (102 mm) above earth or 2 in. (51 mm) above paved areas. Maintain a minimum clearance of 2 in. (51 mm) above roof surfaces. Do not install Thin Tech® panels below grade.

3.6 FASTENERS (For Thin Masonry Support Panel)

- A. Attach fasteners to framing/support members for framed applications. Do not attach Thin Tech® panel to the sheathing alone.
- B. Fasteners for wood studs shall penetrate the studs a minimum of 1-1/4 in. (32 mm).
- C. Fastener Installation: Mechanically attach metal panels with a minimum of one fastener per sq. ft. (929 cm²), reducing fastener spacing along the top and bottom of the wall and around openings, as indicated below.
 - 1. Spacing of pre-punched fastener holes results in the typical recommended fastener spacing of 8 in. (203 mm) vertically and 16 in. (406 mm) horizontally.
 - 2. Fasteners should not be installed behind masonry units, except where they are placed within the channels of Elite Panels.
 - 3. Provide additional fasteners around the perimeter of walls and around openings larger than 24 in. (610 mm) in either dimension, as well as building corners not utilizing corner panels as follows:
 - a. Fasteners shall be placed within 8 in. (203 mm) of the top and bottom of the building walls, at a maximum spacing of 12 in. (305 mm) horizontally.
 - b. At vertical ends of walls and openings, fasteners shall be spaced a maximum of 8 in. (203 mm) vertically within 4 in. (102 mm) of the vertical edge of the panel.
 - c. Where the vertical edge of Thin Tech® Elite Panel is more than 2 in. (51 mm) from a channel, install Thin Tech® Shim and fasten for additional support.

3.7 MASONRY UNITS

- A. Back face of thin brick and surface of metal panel must be dry and clean; free of dirt, oil or and other contaminants.
- B. Prime cast stone and natural stone masonry units, if recommended, according to manufacturer's instructions.
 - 1. Apply primer with a brush or roller at least 1 in. (25 mm) wide in vertical lines no more than 6 in. (152 mm) apart prior to adhering to panel.
 - 2. Do not prime within 1/2" to 1" (13 to 25 mm) of any stone edges.
 - 3. Allow primer to dry completely (at least one hour) before applying adhesive. Reapply primer if structural silicone adhesive is not applied within 8 hours.
- C. Prior to installing veneer units with adhesive, establish unit layout to ensure bond patterns with uniform joint thicknesses and to reduce cutting at openings, movement joints, returns, and offsets.
 - 1. Avoid using less-than-half-size units, particularly at corners and jambs.
 - 2. Avoid using cut units at heads and sills of opening.
 - 3. Ensure unfinished or cut faces are not exposed to view upon completion.
- D. Lay masonry in bond pattern as indicated on drawings or general notes.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of color and texture.

- F. Leave a uniform 3/8 in. to 1/2 in. (10 to 13 mm) space around the perimeter of openings to allow for movement joint installation.
- G. Apply [1 in. (25 mm) diameter dabs of specified adhesive, not more than 6 in. (152 mm) apart to the back of thin brick and adhere units to panel. No less than two dabs/beads shall be applied to each full length unit. Corner units shall have at least one dab/bead of adhesive applied to the head/return.
 - 1. Do not apply adhesive in horizontal streams.
 - 2. Do not use excessive adhesive as this may cause veneer units to tilt away from wall prior to adhesive set.
 - 3. Do not apply silicone adhesive within 1/2 in. to 1 in. (13 to 25 mm) of any stone edges.
- H. Masonry units shall be adhered to dry panel within 5 to 10 minutes after adhesive has been applied and before film begins to form on the adhesive.
- I. When adjustment is necessary to be made after adhesive begins to harden, remove hardened adhesive and replace with fresh adhesive.
- J. Keep areas intended to receive sealant clear of thin brick, adhesive and other materials during construction.
- K. Do not allow masonry units to bridge movement joints in substrate

3.8 MORTAR INSTALLATION AND JOINTING

- A. After adhesive has set a minimum of 6 hours, completely fill head and bed joints intended to receive mortar.
- B. Discard mortar after two hours or when too stiff to work. Retempering within two hours is permitted, but may contribute to mortar color variation.
- C. Do not fill movement joints to receive sealant.
- D. Do not fill joints to receive Glen-Gery Thin Tech[®] Air vent.
- E. Form weep holes (head joints free of mortar) as required in Section 3.9, immediately above starter angles and flashings.
- F. Tool exposed joints when thumbprint hard to joint concave profile.
- G. Flush cut all joints not tooled.
- H. When repointing, completely remove mortar, and refill solidly with mortar and tool joints.

3.9 WEEPHOLES/VENTS

- A. Vents for Elite Panels: Omit mortar from head joints and install vents cut to 2-1/4 in. (57 mm) vertically in head joints.
 - 1. Spacing of weep vents shall not exceed a maximum of 24 in. (610 mm) on center horizontally for units 12 in. (304.8 mm) or less in length and a maximum of 32 in. (813 mm) on center for larger units, in the joint between the flashing and masonry units above or in the lower third of the head joints immediately above the starter angles and flashings, including the base of the wall, at horizontal expansion joints and above all openings.
 - 2. Keep vents free of mortar or other obstructions.

3.10 MOVEMENT JOINTS

- A. Locate movement joints where indicated on drawings.
- B. Provide vertical and horizontal movement joints where indicated by leaving a continuous space no less than 3/8 in. (10 mm) wide between Thin Tech[®] panels, installing bond breaker tape or backer rod as specified and installing sealant as specified in Division 07 Section "Joint Sealants."
 - 1. Provide and install bond breaker tape at movement joints prior to installing masonry units 1 in. (25 mm) or less in thickness. Install backer rod where thickness of masonry unit exceeds 1 in. (25 mm).
- C. Keep entire length of movement joint clear of mortar, Thin Tech[®] adhesive and debris.

- D. Install movement joints between Thin Tech[®] wall assemblies and other materials, including around windows and doors.
- E. Install movement joints at changes in substrate and where movement joints occur in substrate or foundation.
- F. Install movement joints at changes in wall height or thickness.
- G. Spacing of vertical movement joints must not exceed 24 ft. (7.3 m) on center in walls without openings.
- H. Install movement joints at inside corners and within 2 to 4 ft. (0.6 to 1.2 m) of outside corners where intersecting walls (with Thin Tech[®] applied to each) are longer than 4 ft. (1.2 m).
- I. Install no less than one horizontal movement joint per story, with height between horizontal movement joints not exceeding 20 ft. (6.1 m).
- J. Install horizontal movement joints below all starter angles above the base of the wall.

3.11 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses with a dry, non-metallic brush to remove adhesive as well as mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is set and cured, clean exposed masonry as follows:
 - 1. Cut out all defective mortar joints and holes in exposed masonry and fill with new mortar.
 - 2. Clean preselected sample wall area with specified cleaning product as per brick manufacturer's recommendations. Do not use muriatic or hydrofluoric acid. Do not proceed with cleaning until approved by Architect/Owner.
 - 3. Clean thin brick in accordance with cleaning product manufacturer's written instructions.
 - 4. Protect adjacent stone and non-masonry surfaces from contact with cleaner.

3.12 WARRANTY

- A. Provide manufacturer's 25 year warranty against material defects in Thin Tech[®] Elite panels and accessories.
- B. C. Warranty provides for the original purchaser. See warranty for detailed information on terms, conditions and limitations.

SECTION 05120 – STRUCTURAL STEEL**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Structural steel members essential to support the design loads.
- B. Grout

1.02 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 General Requirements apply to this section.
- B. Section 03300 - Cast-In-Place Concrete: For grouting of base plates, and installation of anchor bolts and embeds for anchoring structural steel to concrete.
- C. Section 04200 - Unit Masonry: For installation of anchor bolts and embeds for anchoring structural steel to masonry.
- D. Section 05310 - Steel Deck.
- F. Section 09900 - Painting.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Shop Drawings: Complete fabrication and erection details and schedules.
 - a. Shop Drawings shall have been thoroughly checked by fabricator before being submitted for review. Review is precautionary measure only and shall not relieve fabricator of full responsibility of correctness of materials, sizes, dimensions and details.
 - b. If structural sections and other details indicated on Drawings cannot be readily obtained, substitution of sections and other details of equal strength which conform to requirements of design may be made only if approved.
 - c. Fabrication shall not proceed until shop drawings have been reviewed. Fabrication, assembly and erection shall conform to reviewed shop drawings.

1.04 QUALITY ASSURANCE

- A. Testing Agency: Owner may engage a qualified independent testing and inspection agency to inspect field welds and high strength bolted connections.
- B. Bolted Connections: Shop bolted connections may be tested and inspected according to RCSC's "Specifications for Structural Joints Using ASTM A325 or A490 Bolts."
- C. Welded Connections: Field Welds will be visually inspected according to AWS D1.1
 - 1. In addition to visual inspections, field welds may be tested by Owner according to AWS D1.1 and the following inspection procedures:
 - a. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finish weld. Cracks or zones of incomplete fusion will not be accepted.
 - b. Ultrasonic Inspection: ASTM E 164.
- D. Comply with AISC Manual:
 - 1. "Steel Construction Manual, AISC 360".
- E. Comply with AISC Manual:
 - 1. "A Guide to the Shop Painting of Structural Steel".
 - 2. "Specifications for Architecturally Exposed Structural Steel".
- F. "Code of Standard Practice for Steel Buildings and Bridges":
 - 1. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings".

- G. Welding shall comply with American Welding Society "Structural Welding Code - Steel" AWS D1.1.
- H. "Specifications for Assembly of Structural Joints Using High Strength Steel Bolts" as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Fabricate for delivery sequence which will expedite erection and minimize field handling. Identify pieces with suitable mark conforming to erection drawings.
- B. Deliver structural steel to the Project site and store to avoid damage and distortion of material. Material damaged due to mishandling shall be replaced at no additional cost to the Owner.

1.06 SITE CONDITIONS

- A. Do not perform welding below 0 degrees F. Preheat material to be welded and maintain interpass temperatures as required.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Wide Flange Shapes: ASTM A992.
- B. Angles, Plates, Channels, etc.: ASTM A36
- C. Structural Tubes: ASTM A500, Grade B, 46 ksi.
- D. Welded Connections: AWS D1.1.
- C. Welding Electrodes: AWS Specifications, Serial Designation A233 (E-70).
- D. High Strength Bolts: ASTM A325 or A490.
- E. Anchor Rods: ASTM F1554, Grade 36.
- F. Shop Coat Paint: Fabricators standard rust-inhibiting primer containing no lead-bearing components and meeting current Federal and State regulations concerning lead in paint, and similar to #4080 Red Oxide Zinc Chromate Primer (Hentzen Coatings, Inc.); for interior, normally dry environment.
 - 1. For more severe exposure than those specified above and for architecturally exposed steel such as at pit openings, refer to Division 9 – Painting.
- G. Bituminous Coating: ASTM D1187 asphalt emulsion.

2.02 FABRICATION

- A. Take field measurements as required to verify and supplement dimensions shown on Drawings.
- B. Material shall be properly marked and match-marked where field assembly is required. The sequence of shipments shall be necessary as to expedite and minimize the field handling of material.
- C. Members shall be cambered upward where shown on the Drawings and be so marked for clear identification.
- D. Built-up sections assembled by welding shall be free of warpage, and all axes shall have true alignment.
- E. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AISC.
- F. Shop and field welding shall conform to AWS and AISC Standards and Specification.
- G. Flame cutting of steel will not be permitted.
- H. Provide anchor bolts and embedded plates for anchoring structural steel to supporting concrete and masonry. Furnish detailed plans showing exact locations of all bolts to be built into concrete and masonry as soon as possible. Furnish templates as required.

- I. Connections:
 1. Field connections shall be bolted, with ASTM 325 or A490 bolts unless otherwise shown on Drawings. Tightening shall be done in accordance with Section 5 of AISC Specification for Structural Joints. All bolts shall be torqued to a minimum of 330 ft. pounds and tested with a torque wrench. Field welded connections shall be used only where specifically shown on Drawings or with Structural Engineer's approval.
 2. Shop connections may be welded or bolted with high strength bolts at fabricator's option. Shear connections shall be welded or bolted with high strength bolts.
 3. High strength bolts shall be installed in strict compliance with AISC Specifications and ASTM requirements for installation of bolts.
 4. Field and shop welds shall be by certified welders only. Certificates should be available for inspection by Owner's Construction Manager.
 5. Connections not specifically shown shall fully develop critical load for member being connected.
 6. Bolts where used shall have cut washers under nuts and no threads allowed to bear on parts being connected.
 7. Bearing ends of columns and trusses shall be milled or sawed for true bearing on base and bearing plates. Rough bearing ends shall not be used.

2.03 CLEANING AND SHOP PAINTING

- A. Steel shall be cleaned of rust, mill scale, dirt and foreign matter before application of shop coat of paint.
- B. Paint structural steel with 1 (one) smooth coat of Alkyd primer with SSPC 6 (A) surface preparation.. Apply 2 coats on surfaces not accessible after erection.
- C. Shop coat shall result in a 2 mil (minimum) dry film thickness.
- D. Steel items to be embedded in concrete and steel items to be fireproofed shall not receive shop coat. Steel to receive field welded connections of primary structural importance shall not receive shop coat of paint but shall be painted in field instead.
- E. Hand clean and solvent clean unpainted and damaged shop coat areas and touch-up with a compatible shop coat primer.

PART 3 EXECUTION

3.01 ERECTION

- A. Material stored at the Project site shall not exceed design loads on structures so the members will not be distorted or otherwise damaged; and shall be protected against corrosion or deterioration.
- B. Confer with other trades and procure necessary templates and other information required to establish number, size and location of holes or other details necessary for attachment of items to structural steel.
- C. Burning shall not be used to form holes, enlarge holes or to otherwise modify connections. No member shall be altered in field unless approved in writing by Engineer.
- D. Temporary bracing throughout erection and construction shall be introduced wherever necessary to take care of loads to which structure may be subjected including equipment and operation of same. Wherever piles of material, erection equipment and other loads are carried during erection, proper provisions shall be made to safely support these abnormal loads.
- E. Members shall be cut neat, square and should be erected true and flush without twists and open joints. Light drifting to draw holes together may be used. Reference should be made to codes and specifications listed in this Section under Quality Assurance which govern fabrication, details, erection and workmanship. Responsibility for errors in fabrication and for proper fitting of various members shall be assumed by the structural steel fabricator.

- F. Column bases shall be set on steel shims not to exceed ½" high. Grouting of column bases is specified in Section 03300.
- G. Steel exposed to view shall be free of surface imperfections and ground off to true surfaces. Exposed welds shall be ground smooth.

3.02 ADJUSTING AND CLEANING

- A. After erection, bolts, field welds, and scratched and abraded areas shall be properly cleaned and touched-up with the same paint used for the shop coat. Apply brush or spray paint to provide a minimum dry film thickness of 2 mils.

SECTION 05310 – STEEL DECK**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Non composite floor deck.
- B. Decking accessories.

1.02 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 General Requirements apply to this section.
- B. Section 05120 - Structural Steel
- C. Section 05500 - Metal Fabrications.

1.03 SUBMITTALS

- 1. Manufacturer's Literature: Description of decking and installation instructions.
- 2. Welding certificates
- 3. Field quality control test and inspection reports
- 4. Shop Drawings: Show decking layout, openings required for other parts of the Work, support of decking at openings and sheet metal accessories.

1.04 QUALITY ASSURANCE

- A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Conform with the following:
 - 1. American Iron and Steel Institute "Specification for the Design of ColdFormed Steel Structural Members" (19B0), and specifications.
 - 2. American Welding Society "Structural Welding Code - Sheet Steel" D1.3
 - 3. Steel Deck Institute (SDI) "Design Manual for Composite Decks, Form Decks and Roof Decks".
- C. Welding operators employed to execute welding, shall be previously qualified by test as prescribed in the American Welding Society's "Standard Qualification Procedure" D1.3 or by such other tests as governmental agencies having jurisdiction may prescribe. Welds shall be made only by operators who are qualified to perform the type of work required, as evidenced by their passing the above prescribed tests. Tests completed earlier than 12 months prior to their employment on the work shall not be acceptable. Assume all costs in connection with operator certification.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle the metal decking to avoid damage. When so determined, damaged sheets and related decking materials shall be immediately removed from the Project site. Store sheets and related decking materials so that they are not in contact with the ground and so that they are properly supported, covered and kept dry.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Steel Sheets:
 - 1. Sheet steel for deck and accessories shall conform to ASTM A653 Structural Quality, with a minimum yield strength of 33 ksi.

- B. Shop Finish:
 - 1. Galvanizing shall conform to ASTM A924 with a minimum coating class of G30 (Z090) as defined in A653.

2.02 MANUFACTURER'S

- A. Steel Deck Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Epic Metals Corporation
 - 2. Nucor Corporation; Vulcraft Division
 - 3. Roof Deck, Inc.
 - 4. United Steel Deck, Inc.
 - 5. Verco Manufacturing Company
 - 6. Wheeling Corrugating Company; Division of Wheeling-Pittsburgh Corp.

2.02 DECK TYPES

- A. Provide the deck type as indicated in the drawings.

2.03 ACCESSORIES

- A. Pour stops, end closures, cover plates, and girder fillers shall be the type suitable for the application. Pour stop minimum gages shall be in accordance with the Steel Deck Institute.
- B. Mechanical fasteners or welds shall be permitted for deck and accessory attachment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the supporting work and conditions under which metal decking is to be erected and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install the metal decking and accessories in accordance with the manufacturer's instructions, final Shop Drawings and erection layouts. Place decking units on the supporting steel, align and adjust to final position before permanently fastening. Unless otherwise shown, units shall span 3 or more support spacing. Do NOT stretch or contract the side lap interlocks. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
- B. Deck panels shall be installed on a concrete support structure only after concrete has attained 75% of its specified design strength.
- C. Deck panels and accessories shall be installed according to the SDI Manual of Construction with Steel Deck, placements plans, and requirements of this Section.
- D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

SECTION 05500 – METAL FABRICATIONS**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SECTION INCLUDES

- A. Items fabricated from iron and steel shapes, and plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems in other Sections of these Specifications.
 - 1. Fasteners.
 - 2. Protective primers and coatings.
 - 3. Grout for installation of materials and products specified herein.
 - 4. Prefabricated metal products specified herein.
 - 5. Steel framing and supports for mechanical and electrical equipment.
 - 6. Loose bearing and leveling plates.
 - 7. Steel weld plates and angles for casting into concrete not specified in other Sections.
 - 8. Metal ladders.
 - 9. Metal bollards.
 - 10. Loose steel lintels.
 - 11. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 12. Metal Stairs.
- B. Related Sections include the following:
 - 1. Division Section 03300 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
 - 2. Division Section 04200 "Unit Masonry" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.
 - 3. Division Section 06100 "Rough Carpentry" for metal framing anchors.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Manufacturer's Literature: Material description and installation instructions for products.
 - 2. Shop Drawings: Layout and detail of each miscellaneous metal item shown and specified.
 - 3. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete and masonry construction. Coordinate delivery of such items to Project site.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver iron and steel fabrications to the Project site and store to avoid damage and distortion of materials. Material damaged due to mishandling shall be replaced at no additional cost to the Owner.
- B. Identify pieces with suitable mark for easy location.
- C. Deliver products in their original wrappings or cartons clearly marked for identification and bearing manufacturers name, and model or part number if applicable. Store protected

from damage and the elements. Damaged and otherwise unsuitable materials when so determined, shall be immediately removed from the Project site.

PART 2 PRODUCTS

2.01 METAL MATERIALS

- A. Structural Steel: W-Shapes – ASTM A992. Other Shapes and Plates: ASTM A36.
- B. Steel Plates to be Bent or Formed Cold ASTM A203.
- C. Hot-rolled, Rail Carbon Steel Bars and Shapes: ASTM A499
- D. Cold-finished Steel Bars: ASTM A10.
- E. Steel Pipe: Welded or seamless, ASTM A53, black and hot dipped galvanized.
- F. Steel Tubing: Cold-formed ASTM A50 or hot-rolled ASTM A501.
- G. Galvanized Steel Sheets: ASTM A526.
- H. Aluminum Sheet, Alloy 6063 TS, thickness as indicated on detail.
- I. Stainless Steel Bars and Shapes: Type 304, QQ-S-763, ASTM A276
- J. Bolts and Nuts: ASTM A307, Grade A, galvanized.
- K. Welding Electrodes: AWS Specifications.
- L. Ferrous Metal Primer: SSPC 13-64; FS TT-P-86, Types II; FS TT-P-615
Type II as appropriate for the environmental conditions and compatible with finish painting systems specified.
- M. Galvanized Primer: FS TT-P-641d.
- N. Bituminous Paint Asphalt emulsion ASTM D1187.
- O. Hydraulic Cement: "Porok" (Hallemite Company) "Rocktite" (Hartline Products Co. Inc.); "Five Star Instant Grout" (U.S. Grout Corporation); or Dam-It" (Euclid Chemical Co.).

2.02 METAL FABRICATIONS

- A. General:
 - 1. Fabricate and assemble loose items in the shop and, if necessary, mark to ensure proper installation at the Project site. Disassemble for shipment only to the extent required by shipping limitations.
 - 2. Ease exposed edges of steel shapes.
 - 3. Join parts with hairline contact, flush and smooth with adjacent surfaces using concealed welds and fasteners where possible. Where exposed fastenings are unavoidable, countersink screws and bolts. Grind exposed weld areas smooth to match and blend with finished surfaces.
 - 4. Use hot-rolled steel bars, except where cold-rolled or cold finished arc shown or specified.
 - 5. Weld in accordance with the recommendations of the AWS.
- B. Gate Frame:
 - 1. Fabricate gates and posts from A500 steel tubes as detailed. All joint connections to be full welds, ground smooth. Provide pair of self-closing butts (minimum 3-1/2 x 1-1/2 inches), latch plate and hasp to permit use of padlock, cane bolt and sleeve.
- C. Pit Steel:
 - 1. Steel plate around opening perimeter; see Structural Drawings.
- D. Bollards:
 - 1. Schedule 40 steel 6" diam. X 60" unless specified otherwise.
- E. Hand Rail:
 - 1. Steel pipe, welded with the following:
 - a. Rails: As indicated on drawings.
 - b. Wall Brackets: As indicated on drawings..
- F. Miscellaneous Framing and Support:
 - 1. Provide miscellaneous steel framing and supports which are not a part structural steel framework as required to complete work.

2. Fabricate miscellaneous units to sizes, shapes and profiles shown or if not shown, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
 3. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Except as otherwise shown, space anchors 24" o.c. and provide minimum anchor units of 1-1/4" x 1/4" x 8" steel straps.
- G. Loose Bearing and Leveling Plates:
1. Provide loose bearing and leveling plates for steel items bearing on masonry and concrete construction, made flat, free from warps and twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required.
 2. Galvanize after fabrication.
- H. Miscellaneous Steel Trim:
1. Provide shapes and sizes for profiles shown. Except as otherwise noted, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible.
 2. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.
- I. Loose Lintels:
1. Provide loose structural steel lintels for openings in masonry walls unless otherwise detailed, including openings for mechanical and electrical work.
 2. Loose angle lintels and lintel beams shall be detailed for a minimum bearing of 1" per foot of span, but not less than 8", unless otherwise indicated.
- J. Rough Hardware:
1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel iron shapes as required for framing and supporting wood work, and for anchoring or securing woodwork to concrete and other structures.
 2. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.03 PRIMING AND PROTECTIVE COATING

- A. Clean ferrous metal in accordance with applicable requirements of SSPC-SP1 (Solvent Cleaning) followed by cleaning with applicable requirements of SSPC-SP2 (Hand Tool Cleaning).
- B. Supply specified primer to ferrous metal surfaces by brush or spray to dry film thickness of 2 mils.
- C. Galvanize products as shown or specified in accordance with ASTM A123, A385 and A1223 as applicable.
- D. Paint galvanized surfaces with 1 (one) coat of specified primer, by brush or spray application.
- E. Paint miscellaneous metal work which is to be in contact with but not fully embedded in concrete and masonry with a heavy coat of bituminous paint. Also coat dissimilar metals which are or will be in contact with one another with such paint. Coating shall not extend onto surfaces which will be exposed.
- F. Do not prime or paint sections to be welded in place until after the weld has been performed.
- G. Exposed pit opening steel and surrounding structural steel shall be primed and painted in accordance with Division 9 Painting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which metal fabrications are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting wherever taking field measurements before fabrication might delay work.
- B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- C. Furnish setting drawings, diagrams, templates, instruction and directions for installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete and masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION

- A. General:
 - 1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, throughbolts, lag bolts, wood screws and other connectors as required. Use of lead shield expansion anchors is prohibited.
 - 2. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry and similar construction.
 - 3. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitation. Grind exposed joints smooth and touch-up shop paint coat and screwed field connections.
 - 4. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- B. Installing Bearing and Leveling Plates
 - 1. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
 - 2. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout. Use non-shrink grout.
 - a. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- C. Installing Metal Bollards
 - 1. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
 - 2. Fill bollards solidly with concrete, mounding top surface slightly to shed water with a slick finish.

3.04 ADJUSTING AND CLEANING

- A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and galvanize, and touch-up exposed areas with same material as used for shop coatings. Apply by brush or spray as specified for shop coatings.

SECTION 05600 - MISCELLANEOUS METAL WORK**PART 1 GENERAL****1.01 Drawings and general provisions of the Contract, including General Conditions and Division 01 specification Sections, apply to this Section.****1.02 SUMMARY**

- A. This Section includes the following:
 - 1. Steel pipe railings.

1.03 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Top Rails of Guards: downward.
 - b. Concentrated load of 200 lb applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 200 lb applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain railing through one source from a single manufacturer.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code—Steel."

PART 2 PRODUCTS**2.01 METALS, GENERAL**

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, Roller marks, rolled trade names, stains, discolorations, or blemishes.

2.02 STEEL AND IRON

- A. Pipe: ASTM A 53, Type F or Type S, Grade B, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads
 - 1. Provide galvanized finish for exterior installations and where indicated.
- B. Steel Bars: ASTM A 36.

2.03 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded
- B. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Use primer with a VOC content of 420 g/l (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM 18/19
 - b. ICI Devco Coatings; Catha-Coat 313.
 - c. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
 - d. Sherwin-Williams Company; Corothane I GalvaPac Zinc Primer
 - e. Tnemec Company, Inc.; Tneme-Zinc 90-97
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Non-Shrink, Non-Metallic Grout: Factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.04 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish and anchorage.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form work true to line and level with accurate angles and surfaces.
- D. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- E. Connections: Fabricate railings with welded connections, unless otherwise indicated.
- F. Welded Connections: Cope connections at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 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 flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- G. Form changes in direction by radius bends of radius indicated.
- H. Form simple and compound curves by bending members in jigs to produce uniform curvature for each respective configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

2.05 FINISHES, GENERAL

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

2.06 STEEL AND IRON FINISHES

- A. Galvanized Railings: Hot-dip galvanize exterior steel and iron railings after fabrication.
- B. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Printing: After galvanizing, thoroughly clean railings of grease, dirt, flux, and other foreign matter, and treat with metallic-phosphate process.
- D. Apply shop primer to prepared surfaces of railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification no. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete masonry.

PART 3 EXECUTION**3.01 INSTALLATION, GENERAL**

- A. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished -after fabrication.
 - 2. Set posts plumb within a tolerance of 1/16 inch 3 feet.

3.02 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

3.03 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and $\frac{3}{4}$ inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, non-metallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

3.04 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing comply with ASTM A 780.

3.05 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

SECTION 06100 – ROUGH CARPENTRY**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Wood blocking and nailers.
 - 5. Wood furring and grounds.
 - 6. Plywood backing panels.
- B. Related Sections include the following:
 - 1. Division 06 Section "Sheathing."
 - 2. Division 06 Section "Shop-Fabricated Wood Trusses."

1.03 DEFINITIONS

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

1.04 SUBMITTALS

- A. Product Data (If requested by Owner) 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-preserved 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. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.05 QUALITY ASSURANCE

- A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.
- B. Fire retardant treated wood.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces.

PART 2 PRODUCTS**2.01 WOOD PRODUCTS, GENERAL**

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

3. Wood framing members that are less than 18 inches above the ground in unexcavated areas.
4. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPAC20 (lumber) and AWPAC27 (plywood).
 1. Use Exterior type for exterior locations and where indicated.
 2. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
 3. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Concealed blocking.
 2. Framing for non-load-bearing partitions.
 3. Framing for non-load-bearing exterior walls.
 4. Roof construction.
 5. Plywood backing panels.

2.04 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 19 percent.
- B. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade and any of the following:
 1. Hem-fir (north); NLGA.
 2. Mixed southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Northern species; NLGA.
- C. Exterior and Load-Bearing Walls: Construction or No. 1 grade and any of the following:
 1. Hem-fir (north); NLGA.
 2. Southern pine; SPIB.
 3. Douglas fir-larch; WCLIB or WWPA.
- D. Ceiling Joists (Non-Load-Bearing): Construction or No. 2 grade and any of the following:
 1. Hem-fir (north); NLGA.
 2. Southern pine; SPIB.
 3. Douglas fir-larch; WCLIB or WWPA.
- E. Joists and Other Framing Not Listed Above: Construction or No. 2 grade and any of the following:
 1. Hem-fir (north); NLGA.
 2. Southern pine; SPIB.
 3. Douglas fir-larch; WCLIB or WWPA.

2.05 ENGINEERED WOOD PRODUCTS (As shown on Drawings)

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.
 1. Manufacturers: Subject to compliance with requirements, provide products by

- one of the following:
 - a. Weyerhaeuser Company (I Level)
 - b. Boise Cascade Corporation.
 - c. Georgia-Pacific.
 - d. Louisiana-Pacific Corporation.
- 2. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal depth members.
- 3. Modulus of Elasticity, Edgewise: 1,800,000 psi.
- B. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Weyerhaeuser Company (I Level)
 - 2. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 12-inch nominal depth members.
 - 3. Modulus of Elasticity, Edgewise: 2,200,000 psi.

2.06 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Furring.
 - 5. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Mixed southern pine; SPIB.
 - 3. Spruce-pine-fir; NLGA.
 - 4. Northern species; NLGA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine, No. 2 grade; SPIB.
 - 2. Hem-fir or hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWP.
 - 3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWP.
- D. 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.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.07 PLYWOOD BACKING PANELS

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

2.08 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153 of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.09 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Simpson Strong-Tie Co., Inc.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of products of manufacturer listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.
 - 1. Use for interior locations where stainless steel is not indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Use for exterior locations and where indicated.
- E. Joist Hangers: U-shaped joist hangers with 2-inch long seat and 1-1/4-inch wide nailing flanges at least 85 percent of joist depth.
 - 1. Thickness: 0.062 inch.
- F. I-Joist Hangers: U-shaped joist hangers with 2-inch long seat and 1-1/4-inch wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
 - 1. Thickness: 0.062 inch.
- G. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
 - 1. Strap Width: 2 inches.
 - 2. Thickness: 0.062 inch.
- H. Bridging: Rigid, V-section, nail-less type, 0.050 inch thick, length to suit joist size and spacing.
- I. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post one inch above base and with 2-inch minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.
- J. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
 - 1. Width: 3/4 inch.
 - 2. Thickness: 0.062 inch.
 - 3. Length: 16 inches.
- K. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36

- inches long.
- L. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
 - 1. Bolt Diameter: 5/8 inch.
 - 2. Width: 2-1/2 inches.
 - 3. Body Thickness: 0.138 inch.
 - 4. Base Reinforcement Thickness: 0.239 inch.
 - M. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16 inch deep by 0.034 inch thick with hemmed edges.
 - N. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch thick with hemmed edges.

2.10 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- E. Do not splice structural members between supports, unless otherwise indicated.
- F. Provide blocking and framing as indicated and required to support facing materials, fixtures, specialty items, and trim. Provide metal clips for fastening gypsum board 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.
- G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWWPA 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.
- I. Securely attach rough carpentry work to substrate by anchoring as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- J. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.02 WOOD BLOCKING AND NAILER INSTALLATION

- 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 items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 WOOD FURRING INSTALLATION

- 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 Plywood Paneling: Install 1-by-3-inch nominal size furring horizontally and vertically at 24 inches o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.04 WALL AND PARTITION FRAMING INSTALLATION

- 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 and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction, unless otherwise indicated.
 - 1. For exterior walls, provide 2-by-6-inch nominal size wood studs spaced 16 inches o.c., unless otherwise indicated.
 - 2. For interior partitions and walls, provide 2-by-6-inch or 2-by-4-inch nominal size wood studs spaced 16 inches o.c., unless otherwise indicated.
 - 3. Provide continuous horizontal blocking at midheight 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, except that two studs may be used for interior non-load-bearing partitions.
- 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. Unless otherwise noted on drawings, 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 recommendations of AFPA's "Manual for Wood Frame Construction."

3.05 CEILING JOIST FRAMING INSTALLATION

- A. General: Install ceiling 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 toe nailing or 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 1/3 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 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 3 joists. Embed anchors at least 4 inches into grouted masonry with ends bent at right angles and extending 4 inches beyond bend.
- G. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.
 - 1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal size lumber, double-crossed and nailed at both ends to joists.
 - 2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.06 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

SECTION 06160 - SHEATHING**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Wall sheathing.
 - 2. Roof sheathing.
 - 3. Building wrap.
 - 4. Flexible flashing at openings in sheathing.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for plywood backing panels.

1.03 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 plywood complies 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.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
 - 4. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS**2.01 WOOD PANEL PRODUCTS, GENERAL**

- A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than the thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.02 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWA C9.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood, unless otherwise indicated and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.03 WALL SHEATHING

- A. Plywood Wall Sheathing: Interior with exterior glue, Exposure 1, APA Rated sheathing.
 - 1. Span Rating: Per Drawings.
 - 2. Nominal Thickness: Per Drawings

2.04 ROOF SHEATHING

- A. Plywood Roof Sheathing: Interior with exterior glue, Exposure 1, APA Rated sheathing.
 - 1. Span Rating: Per Drawings.
 - 2. Nominal Thickness: Per Drawings.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

2.06 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Vycor Plus Self-Adhered Flashing.
 - c. MFM Building Products Corp.; Window Wrap.
 - d. Polyguard Products, Inc.; Polyguard 300.
 - e. Protecto Wrap Company; BT-20 XL.
- C. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30S,

Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

- a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
- b. Screw to cold-formed metal framing.
- c. Space panels 1/8 inch apart at edges and ends.

3.03 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant building wrap at bottom and sides of openings.
4. Lap weather-resistant building wrap over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

SECTION 06175 OPEN WEB TRUSSES**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. This work includes the complete furnishings and installation of open-web trusses, as shown on Drawings herein specified and necessary to complete the Work
- B. This Section includes the following:
 - 1. Wood roof trusses.
 - 2. Wood truss bracing.
- C. Related Sections include the following:
 - 1. Division 06 Section "Sheathing" for roof sheathing.

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide open web trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated on Drawings.
 - 2. Maximum Deflection Under Design Loads: Vertical deflection of 1/240 of span.
- B. Delegated Design: Design open-web trusses, including comprehensive load and reaction engineering calculation analysis, Shop Drawings, and other structural data by qualified professional engineer, using performance requirements and design criteria indicated.
- C. Seismic Performance: Structural open web trusses shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1.04 FIRE AND SOUND RATINGS

- A. Fire and sound ratings are to be established in accordance with assemblies detailed in ICC ES Legacy Report No. ESR-1774, or in the Directory of Listed Products published by Intertek Testing Services.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Include data on lumber, adhesives, fabrication, and protection.
 - 2. For preservative-treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 3. For connectors, include installation instructions
 - 4. For metal truss accessories and fasteners.
- B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer. Show fabrication and installation details for trusses.
 - 1. Shop Drawings showing layout and detail necessary for determining fit and placement in the building shall be provided.
 - 2. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.

3. Indicate sizes, stress grades, and species of lumber.
4. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.
7. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 QUALITY ASSURANCE

- A. Each of the open-web trusses shall be identified by a stamp indicating the truss series, ICC ES evaluation report number, manufacturer's name, plant number, date of fabrication, and the independent inspection agency's logo.
- B. Open-web truss products shall be designed and manufactured to the standards set forth in the ICC ES Legacy Report No. ESR-1774, unless otherwise noted
- C. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Owner and authorities having jurisdiction.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and "Supplement."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store open-web trusses to comply with recommendations of TPI HIB
 1. Store open-web trusses vertical position, off of ground, and adequately supported to prevent lateral bending, in accordance with manufacturers written recommendations.
 2. Protect open-web trusses from weather by covering with waterproof sheeting, securely anchored.
 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.
- C. If stored prior to installation, shall be stored in a vertical position and protected from the weather. They shall be handled with care so they are not damaged

1.08 COORDINATION

- A. Time delivery and erection of open-web trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

1.09 WARRANTY

- A. Products delivered shall be free from manufacturing errors or defects in workmanship and material. Open-web trusses, when correctly installed and maintained, shall be warranted to perform as designed for the normal and expected life of the building structure.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Materials shall comply with ICC ES Legacy Report No. ESR-1774. Chord members, web members, connecting pins and bearing hardware/attachments shall be of material and size as required by design.

2.02 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S.
 - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Grade and Species: Provide visually graded dimension lumber for truss chord and web members, of not less than the following grade and the following species:
 - 1. Grade for Chord Members: No. 2 or better.
 - 2. Grade for Web Members: No. 3 or better.
 - 3. Species: Southern pine; SPIB, Douglas fir-larch; WCLIB or WWPA, Spruce-Pine-Fir; NLGA.
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 06 Section "Rough Carpentry."

2.03 TOLERANCES

- A. Length Bearing to Bearing: +/- 1/8-inch for trusses up to 30 feet, +/- 1/4-inch for trusses more than 30 feet
- B. Depth: +/- 1/8-inch
- C. Camber:
 - 1. Trusses up to 30 feet: +/- 1/8-inch
 - 2. Trusses greater than 30 feet to 60 feet: +/- 3/8-inch
 - 3. Trusses greater than 60 feet to 120 feet: +/- 1/2-inch

2.04 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Open-web trusses shall be installed in accordance with the plans, and any shop drawings and installation requirements. Temporary construction loads that cause stresses beyond design limits are not permitted.

1. Open-web trusses shall be designed to fit the dimensions and loads indicated on approved shop drawings.
- B. Provide bracing to keep the trusses straight and plumb as required, and to assure adequate lateral support for the individual trusses and the entire system until the sheathing material has been applied
- C. Fabrication and/or cutting shall not proceed until the Owner has approved the submittal package.
- D. Install wood trusses only after supporting construction is in place and is braced and secured.
- E. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- F. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- G. Install and brace trusses according to TPI recommendations and as indicated.
- H. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- I. Space trusses as indicated on Drawings, adjust and align trusses in location before permanently fastening.
- J. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in truss accessories according to manufacturer's fastening schedules and written instructions.
- K. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 1. Install bracing to comply with Division 06 Section "Rough Carpentry."
- L. Install wood trusses within installation tolerances in TPI 1.
- M. Do not cut or remove truss members.
- N. Replace wood trusses that are damaged or do not meet requirements.
 1. Do not alter trusses in field.

3.02 REPAIRS AND PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

SECTION 06200 FINISH CARPENTRY**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SECTION INCLUDES

- A. Millwork fabrication and installation.
- B. Miscellaneous products specified herein.
- C. Installation of products specified elsewhere.
- D. Plastic laminate products and installation.

1.02 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry.
- B. Section 07900 - Sealants.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Manufacturer's Literature: Descriptions, installation and operating instructions of completely assembled manufactured items other than wood millwork fabricated under this Section.
 - 2. Shop Drawings: Show plans, elevations and details of all wood millwork, indicating materials, species of wood, applied finishes, matching of panels, arrangement, profiles, thicknesses, construction fastenings blocking clearances, assembly and erection details, built-in hardware and necessary connections to other work.
 - 3. Samples: Swatches of plastic laminate and mouldings selected.

1.04 QUALITY ASSURANCE

- A. Custom woodwork shall comply with the applicable requirements of the AWI Quality Standards established by the Architectural Woodwork Institute.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver materials until painting, wet work, grinding, and similar operations which could damage, soil and deteriorate materials, have been completed in installation areas. If, due to unforeseen circumstances, materials must be stored in other than installation areas, store only in areas which meet the requirements specified for installation areas.
- C. Receive and store finish hardware. Properly sort, tag, and file tags.

1.06 PROJECT CONDITIONS

- A. Do not install finish carpentry work until interior concrete and masonry work, and other wet operations are complete, the building is adequately ventilated, and proper temperature and humidity conditions can be maintained during and after installation.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Hardwood lumber for a painted finish shall be clear with no visible defects which must be fill before painting. May be un-selected for color and grain.
- B. Hardwood lumber for transparent finish shall be clear, with no visible defects, and well matched for color and grain.
 - 1. Interior exposed millwork and trim shown on the Drawings as hardwood shall be plain sliced Red Oak.
 - 2. Trim Profiles: Door and window casings, and other wood trim molding patterns selected from industry standards and as shown on the Drawings.
- C. Softwood lumber shall be Ponderosa Pine, Idaho White Pine, Sugar Pine or Northern White Pine. Softwood lumber shall conform to the requirements of Product Standards PS 20-70.
- D. Hardwood plywood and veneer for transparent finish shall be clear, with no visible defects, and well matched for color and grain, conforming to Product Standard PS 51-71. Exposed veneer shall be plain sliced Red Oak.
- E. Softwood Plywood: Product Standards PS 1-83.
- F. Plastic Laminate: General purpose Type GP 50, complying with NEMA Publication No. LD-3, including latest revisions. Refer to architectural drawings for specific selection.
- G. Sanitary Paneling(FRP): Fiberglass reinforced polyester panels, meeting Class III Fire Resistance Rating, complying with USDA and FDA requirements. See drawings.
 - 1. Provide manufacturer's standard vinyl molding strips, suitable for board use.
 - 2. Mold and mildew resistant adhesive for securing sanitary paneling as recommended by the paneling manufacturer.
- H. Stainless steel outside corner guard: Snap on corner guard with retainer (22 ga.)

2.02 FABRICATION

- A. In general millwork shall be fabricated in the shop in largest units possible and delivered to the Project site for installation. Where necessary to fit units at the Project site, allowance shall be made for cutting and fitting.
- B. Not all details of millwork are shown on the Drawings. The fabricator shall utilize the most advantageous manufacturing processes to achieve the quality of millwork indicated herein by reference to AWI Quality Standards.
- C. Fabricate standing and running trim in accordance with AWI Section 300, Custom Grade, including closet hook strips and miscellaneous trim.
- D. Fabricate plastic laminate veneered cabinets, tops, and curbs in accordance with AWI, Section 400, Premium Grade.
 - 1. Cabinet construction shall conform to flush overlay design.
 - 2. Tops, backsplashes, and returns where shown shall be square edge design.
 - 3. Balancing or back-up sheet requirements specified in AWI for plastic laminate veneer.
- E. Plastic laminate veneered butt all joints tight. Textured surface direction shall match with each sheet.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Examine the areas and conditions under which finish carpentry work is to be performed and notify the Contractor in writing of conditions detrimental to the proper and timely

completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Verify measurements at the building and provide necessary closures and trim to fit the items enclosing walls. Provide other trades with information necessary for proper completion of related work.
- B. Condition work to average prevailing humidity conditions in installation areas prior to installing.

3.03 INSTALLATION

- A. General:
 - 1. Work shall be installed by experienced finish carpenters only. Work shall be erected plumb, true and square in a substantial manner. Finished work shall be neatly installed, free of slivers, open joints, hammer and tool marks. Blind nail finished work insofar as possible, and set surface nails.
 - 2. Woodwork: Install, plumb, level, true and straight with no distortions. Shim as required using concealed shims. Cut to fit unless specified to be shop-fabricated or shop-cut to exact size. Where woodwork abuts other finished work, scribe and cut for accurate fit. Before making cutouts, drill pilot holes at corners. Distribute defects allowed in the quality grade specified to the best over-all advantage, when installing job assembled woodwork items.

3.04 INSTALLATION OF STANDING AND RUNNING TRIM

- A. Trim and Mouldings: Install in single, un-jointed lengths for openings and for runs less than 10 feet. For longer runs, use only 1 (one) piece less than 10 feet in any straight run. Stagger joints in adjacent members. Cope at returns and mitre at corners.
 - 1. Attach securely in place with uniform joints providing for thermal and building movements.
 - 2. Nailing: Blind nail where possible. Use fine finishing nails where exposed. Set exposed nail heads for filling.
 - 3. Anchoring: Secure woodwork to anchors or blocking built-in or directly attached to substrates.
- B. Preparation for Finish: Clean woodwork and fill nail holes in preparation for finishes specified under Painting Sections of these Specifications. Where woodwork is to receive a transparent finish, use matching wood filler.

3.05 INSTALLATION OF COUNTERTOPS

- A. Attach countertops securely to blocking and provide cutouts for plumbing fixtures and in-counter soap dispensers, if any. Smooth cut edges of cutouts and coat with waterproof coating or adhesive. Scribe tops to walls.

3.06 INSTALLATION OF SANITARY PANELING

- A. Secure paneling to walls as indicated on Drawings. Apply vinyl molding strips to raw edges of paneling. Butt joints at intersecting walls and apply sealant bead full height of joints. In areas of heavy traffic as determined by the Owner's representative, install stainless steel outside corner guards.

3.07 INSTALLATION OF FINISH DOOR HARDWARE

- A. Apply finish hardware as recommended by hardware manufacturer and as required. Fit lock and latch sets in their respective doors and remove before finishing of doors. Reinstall hardware after finishing of doors is completed. Upon completion, adjust and lubricate hardware for proper operation.
- B. Instruct Owner's personnel in the proper adjustment and maintenance of hardware.

3.08 MISCELLANEOUS INSTALLATION

- A. Install such items as toilet partitions, signage, fire extinguishers, toilet room accessories, miscellaneous specialties, and other items furnished by others requiring fasteners, cutting, trimming, and scribing of furnished materials or finished substrate.
 - 1. Install plumb, level, true and straight.
 - 2. Install according to manufacturer's printed instructions and in accordance with recommendations under the respective Sections.

SECTION 06240 CABINET WORK**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Includes the furnishing of all materials, labor, tools, and equipment required for the installation of the laminate plastic covered cabinet work for the project as herein specified and indicated on the drawings.

1.02 RELATED SECTIONS

- A. Section 06100 Carpentry-Millwork
- B. Section 09250 Gypsum Wallboard System
- C. Section 09920 Interior Painting

1.03 REFERENCE STANDARDS

- A. FS-L-P-508F - Plastic Sheet, Laminated, Decorative and Non-Decorative
- B. FS MMM-A-130A - Adhesive, Contact
- C. PS 1 - Construction and Industrial Plywood
- D. PS 20 - American Softwood Lumber Standard
- E. PS51 - Hardwood and Decorative Plywood
- F. PS 58 - Basic Hardwood
- G. NFPA National Forest Products Association National Design Specification for Stress Grade Lumber and its Fastening.

1.04 SUBMITTALS

- A. Shop Drawings, Samples, Mfg. Data, Color Selections - Submit shop drawings, samples, manufacturer's data and color samples of cabinet millwork in accordance with Section 01340.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Acceptable Products
 - 1. Bellair Series Type "P" as mfgd. by St. Charles Mfg. Co.
 - 2. Nevamar as mfgd. by Midway Industrial Park, Adenton, Maryland 21113.
 - 3. R.F. Creson & Co. (cabinet work), Memphis, TN
 - 4. Saunders Mfg. Co., (cabinet work), Memphis, TN
 - 5. Ken-Rich Millwork Mfg. Co., Memphis, TN
 - 6. Others approved as meeting these specifications.
- B. Substitutions: Items of same function and performance are acceptable in conformance with Section 01600.

2.02 MATERIAL AND CONSTRUCTION

- A. Tops and splash backs shall be 1/16" laminate plastic as manufactured by Wilson Art or approved as meeting these specifications.

- B. All parts are factory prefinished. Flush fronts overlap ends. Cabinet body panel joints are assembled with specially designed male and female nickel plated hardware applied so any panel or part may be replaced by disengaging hardware and removing sheet metal screws from back of cabinet. All end panels are of flush construction finished in pattern matching fronts. All exposed panel edges have extruded, shock-proof, ethyl-cellulose T-molding applied to grooved edge. Cabinet backs are rigidly screwed into rabbeted ends with sheet metal screws 1-1/4" long.
- C. Doors - 1/2" thick core, veneered on both sides with high-pressure plastic laminate with edges sealed with shock-proof T-molding.
- D. Drawers - Fronts are 1/2" thick core, veneered on both sides with textured high-pressure plastic laminate with all edges sealed with shock-proof T-molding. Drawer sides, inner fronts, and backs are 1/2" core veneered with matching high pressure plastic cabinet liner. All exposed edges are sealed with T-molding. Drawer bottoms are 1/8" hardboard core veneered with impervious textured Beige Scrim high-pressure cabinet liner. Drawers glide on plated steel slides with nylon, ball bearing rollers with positive stop. Drawers are easily manufactured for cleaning and have rubber bumpers to eliminate noise. All as manufactured by K & V hardware supplier.
- E. Cabinet tops, bottoms, ends and backs shall be 1/2" thick core, veneered both sides with matching high-pressure plastic cabinet liner or phenolic balancing sheet. All exposed edges sealed with shock-proof extruded T-edge.
- F. Shelves - 1/2" thick core, veneered both sides with matching high pressure cabinet liner. Upper and full height cabinet shelves are adjustable on 1/2" centers. Base cabinet shelves are adjustable on 1-1/2" centers.
- G. Recessed toe space - Integral 4" high, 3" deep toe space surfaced with textured black plastic laminate.

2.03 FINISH

- A. All cabinets have exposed surface covered with textured high pressure laminates. All cabinet fronts are high pressure .035" thick textured melamine vertical surfacing laminate in accordance with NEMA standards. Cabinet interiors and ends are surfaced in matching high pressure plastic cabinet liner. Unexposed outside surfaces are covered with a balancing sheet of phenolic, moisture-resistant backing material. Color as selected.

2.04 HARDWARE

- A. Provide all required hardware.
- B. Finish shall be chrome.
- C. All hardware shall be K & V or approved by Owner. Submit sample.

2.05 LAMINATE PLASTIC COUNTER AND BASE CABINETS

- A. Furnish and install laminate plastic counter and base cabinets, as detailed. Provide end and backsplash on countertops. Secure to wall framing with bolts and washers.
- B. Color of laminate plastic as selected by Owner.
- C. Provide cut out for sink, etc., all as required.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Set and secure cabinet work and finish carpentry items in place rigid, plumb and square.
- B. Use purpose designed fixture attachments for wall mounted components.
- C. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units, countertops and base cabinets.
- D. Permanently fix cabinet and counter bases to floor using appropriate angles and anchorages.
- E. Carefully scribe cabinet work which is against other building materials, leaving gaps of 1/32" maximum. Do not use additional overlay for this purpose.
- F. Install and adjust cabinet hardware to insure smooth and correct operation. All cabinet hardware furnished by this section.
- G. Sink, faucets, trap, etc., furnished and installed by Section 15400.

SECTION 06640 - PLASTIC PANELING**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.
- B. Related Sections:
 - 1. Division 06 Section "Rough Carpentry" for wood furring for installing plastic paneling.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
 - 3. Testing Agency: Acceptable to authorities having jurisdiction.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weather-tight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Allow material to adjust to room temperature (min. 24 hours) prior to beginning the installation: maintain an environment of 65°F - 75°F
- C. Do not store or stand panels on end.

1.5 WARRANTY

- A. Contractor shall guarantee that the materials and application fulfills all conditions as stated in these specifications. Should any workmanship or materials covered by these specifications be proven defective within the guarantee period, of 5 years, Contractor shall repair or replace the workmanship and materials without charge to Owner.
- B. Any deviation from this specification shall be approved in writing by Company. Failure of Contractor to consult with Owner representative to clarify any item in the specification will in no way relieve the Contractor of his responsibility for satisfactory compliance with these specifications.

PART 2 PRODUCTS**2.0 PLASTIC SHEET PANELING**

- A. FRP: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. As noted in drawings.
 - 2. Nominal Thickness: Not less than 0.12 inch.
 - 3. Surface Finish: As noted in drawings.
 - 4. Color: As noted in drawings.
 - 5. Location: As noted in drawings.
- B. Pre-laminated wall panels: square edged on 1/4" thick substrate.
 - 1. Manufacturer: Construction Specialties Group. Contact: 800-233-8493
 - 2. Nominal thickness of Acrovyn laminate: .060" excluding substrate.
 - 3. Surface Finish: As noted in drawings.
 - 4. Color: As noted in drawings.
 - 5. Location: As noted in drawings.

2.1 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard two-piece, snap-on vinyl extrusions designed to cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
 - 1. Color: White.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- D. Adhesive: As recommended by plastic paneling manufacturer.
 - 1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."
 - 1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.0 EXAMINATION

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

3.1 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 18 inches wide.

1. Mark plumb lines on substrate at panel joint with trim accessories locations for accurate installation.
2. Locate panel joints with trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.2 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
 1. Maintain panel orientation throughout the entire installation.
 2. Wipe the back of the wall panel with a clean, damp cloth before installation, to remove any dust and dirt.
 3. Wipe the wall to remove any dust or dirt.
- B. Install panels in a full spread of adhesive. Follow manufacturer's recommendations for adhesive material and application methods.
- C. Install trim accessories with adhesive and nails. Do not fasten through panels.
- D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

3.3 CLEANING

- A. Immediately remove any adhesive that may have accidentally gotten on the panel using cleaners recommended by the manufacturer of the panel and adhesive.
- B. Do not use Methyl Ethyl Ketone (MEK) or any similar solvents to clean FRP or Pre-laminated Wall Panel surfaces.
- C. Do not use Scotch-Brite pads, steel wool or similar cleaning pads on FRP or Pre-laminated Wall Panels.

SECTION 07132 - PRE-APPLIED SHEET MEMBRANE WATERPROOFING**PART 1- GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. The Work of this Section includes, but is not limited to, "Preprufe 300R" pre-applied sheet membrane waterproofing that forms an integral bond to poured concrete for the following applications:
 - 1. Horizontal Applications: Membrane applied on prepared subbase prior to placement of concrete slabs.
- B. Related Section:
 - 1. Division 03 Section "Concrete Formwork"
 - 2. Division 03 Section "Cast-in-Place Concrete"
 - 3. Division 07 Section "Self-Adhering Sheet Waterproofing"

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: SUBMITTAL NOT REQUIRED BY ARCHITECT. PROVIDE DOCUMENTS TO VIOC Construction Manager if required. Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: Manufacturer's membrane samples
- D. Qualification Data: For Installer.
- E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- F. Field quality-control reports.
- G. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm which has at least 3 years' experience in work of the type required by this section.
- B. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.
- C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.
- D. Schedule Coordination: Schedule work such that membrane will not be left exposed to weather for longer than recommended by the manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's instructions. Protect from damage from weather, excessive temperature and construction operations. Remove and dispose of damaged material in accordance with applicable regulations.

1.5 PROJECT CONDITIONS

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.6 WARRANTY

- A. Special Manufacturer's Warranty: Sheet Membrane Waterproofing: Provide written five year material warranty issued by the membrane manufacturer upon completion of work
- B. Special Installer's Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.
 - 1. Warranty includes removing and reinstalling waterproofing membrane and affected areas.

PART 2- PRODUCTS

2.0 WATERPROOFING SYSTEM PRODUCTS

- A. Pre-Applied Integrally Bonded HDPE Sheet Waterproofing Membrane for vertical or horizontal application: PREPRUFE® 300R Plus Membrane [or PREPRUFE® 300R Plus LT Membrane for application temperatures between 25°F (-4°C) and 60°F (+16°C)] as manufactured by GCP Applied Technologies, a 1.2mm (0.046 in) nominal thickness composite sheet membrane consisting of 0.8 mm (0.030 in.) of high density polyethylene film, a pressure-sensitive adhesive and a trafficable weather resistant coating. The membrane shall be supplied in a kick-out roll orientation and shall have no release liner to reduce waste onsite. The membrane shall form an integral, adhesive and permanent bond to poured concrete to prevent water migration at the interface of the membrane and structural concrete and shall include dual adhesive ZipLap™ seam technology to complete side laps and secure adjacent sheets. Provide membrane with the following physical properties:

NOTE: PREPRUFE® 300R Plus and PREPRUFE® 300 R Plus LT can both be installed at temperatures 25°F (-4°C) and above. For temperatures 25°F (-4°C) to 40°F (4°C) the use of PREPRUFE® LT Tape is recommended at all side laps when using PREPRUFE® 300R Plus. Alternatively, contractors may elect the use of PREPRUFE® 300R Plus LT, which does not require the use of PREPRUFE® LT Tape at side laps in temperature ranges 25°F (-4°C) to 40°F (4°C). For this reason, GCP Applied Technologies suggests that both products be incorporated into the specification.

PHYSICAL PROPERTIES FOR PREPRUFE® 300R Plus (or 300R Plus LT) MEMBRANE:

Property	Test Method	Typical Value
Color	NA	White with Yellow and Blue Zip Strips in the Side Lap Area
Thickness	ASTM D 3767 Method A	0.046 in. (1.2 mm) nominal

Property	Test Method	Typical Value
Lateral Water Migration Resistance	ASTM D 5385 Modified ¹	Pass at 231 ft (71m) of hydrostatic head pressure
Low Temperature Flexibility	ASTM D 1970	Unaffected at -20°F (-29°C)
Resistance to Hydrostatic Head	ASTM D 5385 Modified ²	231 ft (71m)
Elongation	ASTM D 412 Modified ³	400%
Tensile Strength, film	ASTM D 412	4,000 psi (27.6 MPa)
Crack Cycling at -9.4°F (-23°C), 100 Cycles	ASTM C 836	Unaffected, Pass
Puncture Resistance	ASTM E 154	200 lbs (890 N)
Peel Adhesion to Concrete	ASTM D 903 Modified ⁴	5.0 lbs/in. (880 N/m)
Lap Peel Adhesion	ASTM D 1876 Modified ⁵	8.0 lbs/in. (1408 N/m)
Permeance to water vapor transmission	ASTM E 96 Method B	0.01 perms (0.6 ng/Pa x s x m ²)

Footnotes:

1. Lateral water migration resistance is tested by casting concrete against membrane with a hole and subjecting the membrane to hydrostatic head pressure with water. The test measures the resistance of lateral water migration between the concrete and the blind side waterproofing membrane. A hydrostatic head pressure of 71 m (231 ft) of water is the limit of the apparatus.
2. Hydrostatic head tests are performed by casting concrete against the membrane with a lap. Before the concrete sets a 3 mm (0.125 in.) spacer is inserted perpendicular to the membrane to create a gap. The cured block is placed in a chamber where water is introduced to the membrane surface up to a head of 71 m (231 ft) of water which is the limit of the apparatus.
3. Elongation of membrane is run at a rate of 50 mm (2 in.) per minute.
4. Concrete is cast against the protective coating surface of the membrane and allowed to cure (7 days minimum). Peel adhesion of membrane to concrete is measured at a rate of 50 mm (2 in.) per minute at room temperature.
5. The test is conducted 15 minutes after the lap is formed as per manufacturer's instructions and run at a rate of 50 mm (2 in.) per minute.

2.1 ANCILLARY PRODUCTS

- A. Waterstop: ADCOR® hydrophilic waterstop or DE NEEF® Injecto® Tube groutable waterstop by GCP Applied Technologies for non-moving concrete construction joints.
- B. Preformed Soil Retention Wall Tieback Cover: PREPRUFE® Tieback Cover by GCP Applied Technologies as a prefabricated detail for soil retention wall tiebacks.
- C. Tape for covering cut edges, roll ends, penetrations and detailing: PREPRUFE® Tape LT (for temperatures between 25°F (-4°C) and 86°F (30°C)) and PREPRUFE® Tape HC (for use in Hot Climates, minimum 50°F (10°C))
- D. Miscellaneous Materials: accessories specified or acceptable to manufacturer of pre-applied waterproofing membrane.

PART 3- EXECUTION**3.0 EXAMINATION**

- A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the Contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.1 SUBSTRATE PREPARATION

- A. It is essential to create a sound and solid substrate to eliminate movement during the concrete pour. Substrates must be regular and smooth with no gaps or voids greater than 0.5 in. (12 mm). Grout around all penetrations such as utility conduits, etc. for stability.
 - 1. Horizontal Surfaces - The substrate must be free of loose aggregate and sharp protrusions. Avoid curved or rounded substrates. When installing over earth or crushed stone, ensure substrate is well compacted to avoid displacement of substrate due to traffic or concrete pour. The surface does not need to be dry, but standing water must be removed.

3.2 INSTALLATION, HORIZONTAL APPLICATIONS

- A. Strictly comply with installation instructions in manufacturer's published literature, including but not limited to, the following:
 - 1. Place the PREPRUFE® 300R membrane HDPE film side to the substrate with the clear plastic release liner facing towards the concrete pour. End laps should be staggered to avoid a build-up of layers.
 - 2. Leave the plastic release liner in position until overlap procedure is completed.
 - 3. Accurately position succeeding sheets to overlap the previous sheet 3 in. (75 mm) along the marked selvedge. Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap.
 - 4. Peel back the plastic release liner from between the overlaps as the two layers are bonded together. Ensure a continuous bond is achieved without creases and roll firmly with a heavy roller.
 - 5. Completely remove the plastic liner to expose the protective coating. Any initial tack will quickly disappear.

3.3 WATERSTOP INSTALLATION

- A. Strictly comply with installation instructions in manufacturer's published literature, including but not limited to, the following:
 - 1. Secure ADCOR® hydrophilic waterstop using masonry nails 1½ in. - 2 in. (40 mm – 50 mm) long with a washer ¾ in. (20 mm) in diameter. Hilti EM6-20-12 FP8 shot fired fixings with ¼ in. (6 mm) nuts and ¾ in. (20 mm) diameter washers may also be used. Fixings should be spaced at a maximum of 12 in. (300 mm) centers with a minimum spacing that ensures proper contact to substrate.
 - 2. On irregular concrete faces, apply a ½ in. (12 mm) bead of ADCOR® Adhesive as bedding for ADCOR® hydrophilic waterstop.
 - 3. ADCOR® hydrophilic waterstop joints should overlap a minimum of 4 in. (100 mm), ensuring full contact between jointed pieces.

3.4 PROTECTION

- A. Protect membrane in accordance with manufacturer's recommendations until placement of concrete. Inspect for damage just prior to placement of concrete and make repairs in accordance with manufacturer's recommendations.

SECTION 07133 - SELF-ADHERING SHEET WATERPROOFING**PART 1- GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. The work of this section includes, but is not limited to, the following:
 - 1. Rubberized asphalt sheet membrane waterproofing system
 - 2. Prefabricated drainage composite
 - 3. Protection board
- B. Related Section:
 - 1. Division 03 Section "Concrete Formwork"
 - 2. Division 03 Section "Cast-in-Place Concrete"
 - 3. Division 07 Section "Pre-Applied Sheet Membrane Waterproofing"

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: SUBMITTAL NOT REQUIRED BY ARCHITECT. PROVIDE DOCUMENTS TO VIOC Construction Manager if required. Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples:
 - 1. Sheet membrane
 - 2. Protection board
 - 3. Prefabricated drainage composite
- D. Qualification Data: For Installer.
- E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- F. Field quality-control reports.
- G. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm which has at least 3 years' experience in work of the type required by this section.
- B. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.
- C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.
- D. Schedule Coordination: Schedule work such that membrane will not be left exposed to weather for longer than recommended by the manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.
 - 1. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
 - 2. Protect surface conditioner from freezing.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.
- C. Safety and Handling: Users must read and understand the product label and Safety Data Sheets (SDS's) for each system component before use. All users must acquaint themselves with this information prior to working with the material. Carefully read detailed precaution statements on the product labels and SDS's before use.

1.5 PROJECT CONDITIONS

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
- B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.6 WARRANTY

- A. Sheet Membrane Waterproofing: Provide written 5 year material warranty issued by the membrane manufacturer upon completion of the work.

PART 2- PRODUCTS

2.0 WATERPROOFING SYSTEM PRODUCTS

- A. Sheet Membrane Waterproofing System: BITUTHENE® System 4000 Membrane as manufactured by GCP Applied Technologies; a self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 in.) of rubberized asphalt and 0.1 mm (0.004 in.) of cross-laminated, high density polyethylene film specially formulated for use with water-based surface conditioner. Provide rubberized asphalt membrane covered with a release sheet, which is removed during installation and no special adhesive or heat shall be required to form laps. Provide membrane with the following physical properties:

PHYSICAL PROPERTIES FOR BITUTHENE® SYSTEM 4000 MEMBRANE:

Property	Test Method	Typical Value
Color		Dark gray-black
Thickness	ASTM D 3767 Method A	60 mils (1.5 mm) nominal
Flexibility, 180° bend over 25 mm (1 in.) mandrel at -32°C (-25°F)	ASTM D 1970	Unaffected
Tensile Strength, Membrane Die C	ASTM D 412 ¹	2240 kPa (325 psi) minimum
Tensile Strength, Film	ASTM D 882 ¹	34.5 MPa (5,000 psi) minimum
Elongation, Ultimate Failure of Rubberized Asphalt	ASTM D 412 ¹	300% minimum
Crack Cycling at -32°C (-25°F), 100 Cycles	ASTM C 836	Unaffected
Lap Shear	ASTM D 1002 ²	89 N (20 lbs.) minimum

Property	Test Method	Typical Value
Peel Strength	ASTM D 903	1926 N/m (11 lbs/in.) minimum
Puncture Resistance, Membrane	ASTM E 154	222 N (50 lbs.) minimum
Resistance to Hydrostatic Head	ASTM D 5385	>70 m (>230 ft) of water
Permeance	ASTM E 96, Section 12 – Water Method	<0.1 perms
Water Absorption	ASTM D 570	0.1% (maximum)

Footnotes:

1. The test is run at a rate of 50 mm (2 in.) per minute.
2. The test is run at a rate of 100 mm (4 in.) per minute

2.1 ANCILLARY PRODUCTS – (reference gcpat.com for complete technical details)

- A. Prefabricated Drainage Composite: HYDRODUCT® 220 and/or HYDRODUCT® 660 Drainage Composite as manufactured by GCP Applied Technologies to promote positive drainage while serving as a protection course.
NOTE TO SPECIFIER: The following are product selection guidelines for HYDRODUCT® Drainage Composites. Consult the “Product Summary” and “System Components” section of the Waterproofing Systems Manual North American Edition for complete information. HYDRODUCT® 220 drainage composite: All vertical applications. HYDRODUCT® 660: All horizontal applications. THE APPROPRIATE HYDRODUCT® DRAINAGE COMPOSITE MAY ALSO SERVE AS PROTECTION FOR ALL BITUTHENE® MEMBRANES.
- B. Protection Board:
 1. Expanded Polystyrene Protection Board: 25 mm (1 in.) thick for vertical applications with the following characteristics. Adhere to waterproofing membrane with BITUTHENE® Protection Board Adhesive.
 - a. Normal Density: 16 kg/m³ (1.0 lb/ft³)
 - b. Thermal Conductivity, K factor: 0.24 at 5°C (40°F), 0.26 at 24°C (75°F)
 - c. Thermal Resistance, R-Value: 4 per 25 mm (1 in.) of thickness.
 2. Asphalt Hardboard: A pre-molded semi-rigid protection board consisting of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 in.) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two layers of 3 mm (0.125 in.) thick hardboard or one layer of 6 mm (0.25 in.) thick hardboard.
- C. Waterstop: Adcor™ hydrophilic waterstop as manufactured by GCP Applied Technologies for non-moving concrete construction joints.
- D. Miscellaneous Materials: Surface conditioner, mastic, liquid membrane, tape and accessories specified or acceptable to manufacturer of sheet membrane waterproofing.

PART 3- EXECUTION**3.0 EXAMINATION**

- A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the Contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.1 SUBSTRATE PREPARATION

- A. Refer to manufacturer’s literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed

surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

- B. Cast-In-Place Concrete Substrates:
 - 1. Do not proceed with installation until concrete has properly cured and dried (minimum 7 days for normal structural concrete and minimum 14 days for lightweight structural concrete).
 - 2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
 - 3. Repair bugholes over 13 mm (0.5 in.) in length and 6 mm (0.25 in.) deep and finish flush with surrounding surface.
 - 4. Remove scaling to sound, unaffected concrete and repair exposed area.
 - 5. Grind irregular construction joints to suitable flush surface.
- C. Masonry Substrates: Apply waterproofing over concrete block and brick with smooth trowel-cut mortar joints or parge coat.
- D. Wood Substrates: Apply waterproofing membrane over securely fastened sound surface. All joints and fasteners shall be flush to create a smooth surface.
- E. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

3.2 INSTALLATION

- A. Refer to manufacturer's literature for recommendations on installation, including but not limited to, the following:
 - 1. Apply surface conditioner at rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of surface conditioner.
 - 2. Delay application of membrane until surface conditioner is completely dry. Dry time will vary with weather conditions.
 - 3. Seal daily terminations with troweled bead of mastic.
 - 4. Apply protection board and related materials in accordance with manufacturer's recommendations.

3.3 CLEANING AND PROTECTION

- A. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.
- B. Inspect for damage just prior to installation of subsequent construction activities and make repairs in accordance with manufacturer's recommendation.

SECTION 07190 - MASONRY WATER REPELLENTS**PART 1- GENERAL****1.0 RELATED DOCUMENTS**

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

1.1 SUMMARY

- A. This Section includes penetrating water-repellent coatings for the following surfaces:
 - 1. Concrete unit masonry (unpainted and unglazed).
- B. Related Sections include the following:
 - 1. Division 04 Section "Unit Masonry" for integral water-repellent admixture for unit masonry assemblies.
 - 2. Division 07 Section "Joint Sealants."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include manufacturer's printed statement of VOC content.
 - 2. Include manufacturer's standard colors.
- B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.
- C. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.
- D. Qualification Data: For Installer and testing agency.
- E. Preconstruction Testing Reports: For water-repellent-treated substrates.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.
- G. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: If requested by Owner, an independent agency qualified according to ASTM E 548 for testing indicated.
- C. Test Application: Apply a finish sample for each type of water repellent and substrate required. Duplicate finish of approved sample.
 - 1. Locate each test application as directed by Owner.
 - 2. Size: 25 sq. ft., minimum.
 - 3. Apply in accordance with manufacturer's written instructions.
 - 4. Allow protective treatment test area to cure prior to inspection.
 - 5. Final approval by Architect of water-repellent application will be from test applications.

1.4 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 - 1. Ambient temperature is above 40 deg F.
 - 2. Masonry surfaces and mortar have cured for more than 28 days.

3. Masonry walls are not treated prior to 30 days after building close-in.
4. Rain or snow is not predicted within 24 hours.
5. Application proceeds more than 24 hours after surfaces have been wet.
6. Substrate is not frozen, or surface temperature is above 40 deg F.
7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agrees to repair or replace materials that fail to maintain water repellency within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2- PRODUCTS

2.0 PENETRATING WATER REPELLENTS

- A. Water Based Silicone Emulsion Water Repellant: Clear-drying, water-based silicone emulsion for weatherproofing concrete block and other porous masonry materials, protects masonry surfaces from graffiti attacks without altering the natural appearance; protects exterior walls exposed to normal weathering.

2.1 MANUFACTURERS

- A. Products:
 - a. ProSoCo, Inc.; Sure Klean Weather Seal Blok-Guard & Graffiti Control WB 6.

PART 3- EXECUTION

3.0 PREPARATION

- A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water-repellent manufacturer's written instructions, to ensure that surface is dry enough.
- B. Test for pH level, according to water-repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.
- C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.
- D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

- B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
- C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.2 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

SECTION 07191 – WATER REPELLANT SEALER FOR SERVICE BAY CONCRETE**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Water repellent sealer for interior or exterior concrete surfaces as scheduled.
- B. Related Sections:
 - 1. Section 03300 Cast-in-Place Concrete.

1.2 SUBMITTALS

- A. Comply with Section 01340 Shop Drawings, Product Data and Samples.
- B. Product Data: Submit manufacturer's technical data sheets.
- C. Submit list of project references as documented in this specification under Quality Assurance Article. Include contact name and phone number of the person charged with oversight of each project.
- D. Quality Control Submittals:
 - 1. Provide protection plan of surrounding areas and non-work surfaces.

1.3 QUALITY ASSURANCE

- A. Comply with Section 01410 Inspection, Sampling and Testing Laboratory Services.
- B. Qualifications:
 - 1. Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products.
 - 2. Manufacturer Qualifications: Company shall be ISO 9001:2015 Certified.
 - 3. Applicator Qualifications: Company with minimum of 5 years' experience in application of specified products on projects of similar size and scope and is acceptable to product manufacturer.
 - a. Successful completion of a minimum of 5 projects of similar size and complexity to specified work.
- C. Field Sample:
 - 1. Install field sample at project site or other pre-selected area, as directed by architect/engineer.
 - a. Provide mockup of at least 100 sf (9.3 m²) to include surface preparation, sealant joint, and juncture details and allow for evaluation of repellent performance and finish.
 - b. Conduct absorption test on cured field sample. Adjust application until required repellent performance is achieved.
 - c. Apply material in accordance with manufacturer's written application instructions.
 - 2. Manufacturer's representative or designated representative will review technical aspects; surface preparation, application and workmanship.
 - 3. Field sample will be standard for judging workmanship on remainder of project.
 - 4. Maintain field sample during construction for workmanship comparison.
 - 5. Do not alter, move, or destroy field sample until work is completed and approved by architect/engineer.
 - 6. Obtain architect/engineer written approval of field sample before start of material application, including approval of aesthetics, color, texture, and appearance.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01610 Delivery, Storage and Handling.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

- C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Store in unopened containers in clean, dry area between 35 degrees F (2 degrees C) and 110 degrees F (43 degrees C).

1.5 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Minimum application temperature is 20 degrees F (minus 7 degrees C) and rising.
 - 2. Do not apply in rain or when rain is expected within 4 hours. Do not apply above 95 degrees F (35 degrees C) or below 40 degrees F (4 degrees C) or when temperatures are expected to fall below 20 degrees F (minus 7 degrees C) within 12 hours.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from the following manufacturer:
Sika Corporation
201 Polito Avenue
Lyndhurst, NJ 07071
Phone: 800-933-7452
Fax: 201-933-6225
Website: www.sika.com
- B. Substitutions: Comply with Section 01340.
- C. Specifications and drawings are based on manufacturer's proprietary literature from Sika Corporation. Other manufacturers shall comply with minimum levels of material and detailing indicated in specifications or on drawings. Architect/engineer will be sole judge of appropriateness of substitutions.

2.2 MATERIALS

- A. Clear, breathable, high-performance, 100 percent silane sealer for protecting new and existing concrete surfaces. Penetrates deeply, sealing out water, chloride ions, and acids, preventing damage from freeze/thaw cycles.
 - 1. Acceptable Product: Sikagard H 1001 by Sika Corporation. This product is the sealer to be applied to the upper level floor (over top of the HD 200 WB specified in Section 03923).
- B. Water repellant sealer complies with the following requirements:
 - 1. Compliance: Alberta DOT, Type 1c.
 - 2. Silane Content by Weight: 100 percent.
 - 3. Penetration, average depth, depending upon substrate: 0.35 inch (9 mm).
 - 4. Surface Appearance after Application: Unchanged.
 - 5. Flash Point, SETA: Greater than 165 degrees F (62.7 degrees C).
 - 6. Waterproofing Repellency after Heavy Abrasion, Alberta DOT penetrating sealer, Type 1c, 0.35 w/c ratio: 83.5 percent.
 - 7. Water Weight Gain, NCHRP 244 Series II Cube Test:
 - a. 250 sf per gal (6.1 m²/L): 90 percent reduction.
 - b. 400 sf per gal (9.8 m²/L): 85 percent reduction.
 - 8. Absorbed Chloride, NCHRP 244 Series II Cube Test:
 - a. 250 sf per gal (6.1 m²/L): 96 percent reduction.
 - b. 400 sf per gal (9.8 m²/L): 87 percent reduction.
 - 9. Absorbed Chloride, NCHRP 244 Series IV Southern Climate: 98 percent reduction.
 - 10. VOC Content:
 - a. 3.05 lbs per gal (365 g/L), less water and exempt solvents.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply with Section 01700 Project Closeout.

3.2 SURFACE PREPARATION

- A. Protection: Protect plant life and surfaces to remain uncoated during application. Use drop cloths or masking as required.
- B. Prepare surfaces in accordance with manufacturer's instructions.
- C. Verify substrate has properly cured. Surfaces shall be clean and structurally sound. Remove dust, dirt, oil, grease, chemical films, coatings and other contaminants before application.
- D. Do not apply sealer if standing water is visible on surface to be treated.

3.3 APPLICATION

- A. Apply sealer in accordance with manufacturer's instructions.
- B. Stir material thoroughly before and during application.
- C. Apply sealer with flooding action. Eliminate ponding.
- D. Apply even distribution of sealer.

3.4 PROTECTION

- A. Protect sealer from damage during construction.

END OF SECTION

SECTION 07210 - BUILDING THERMAL INSULATION**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Perimeter insulation under slabs-on-grade.
 - 2. Perimeter wall insulation (supporting backfill).
 - 3. Concealed building insulation.
 - 4. Vapor retarders.
- B. Related Sections include the following:
 - 1. Division 04 Section "Unit Masonry" for insulation installed in masonry cells.
 - 2. Division 07 Section "Water-Drainage Exterior Insulation and Finish System (EIFS)" for insulation specified as part of these systems.
 - 3. Division 07 Section "Thermoplastic Membrane Roofing" for insulation specified as part of roofing construction.
 - 4. Division 09 Section "Gypsum Board" for installation in metal-framed assemblies of insulation specified by referencing this Section.
 - 5. Division 22 Section "Plumbing Insulation."
 - 6. Division 23 Section "HVAC Insulation."

1.2 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: If Requested by Owner; based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

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

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
 - 1. Manufacturers:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company.
 - c. Owens Corning.
 - d. Pactiv Building Products Division.
 - 2. Type IV, 1.60 lb/cu. ft., unless otherwise indicated.

2.2 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation.
 - 2. Guardian Fiberglass, Inc.
 - 3. Johns Manville.
 - 4. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics, and formaldehyde free.
- C. Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on 1 face, and formaldehyde free.

2.3 VAPOR RETARDERS

- A. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: 2-outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 10.5 kg.100 sq. m (22 lb/1000 sq. ft.), with maximum permeance rating of 7.5 ng/Pa x s x sq. m (0.1317 perm) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively.

1. Products:
 - a. Raven Industries Inc.; DURA-SKRIM 2FR.
 - b. Reef Industries, Inc.; Griffolyn T-55 FR.
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- D. Single-Component Non-Sag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, use NT related to exposure, and Use O related to vapor-barrier-related substrates.

2.4 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
 1. Products:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
 - c. Gemco; Spindle Type.
 2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
- B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
 1. Products:
 - a. AGM Industries, Inc.; TACTOO Adhesive.
 - b. Eckel Industries of Canada; Stic-Klip Type S Adhesive.
 - c. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. If not otherwise indicated, extend insulation from underside of slab on grade to top of concrete footing.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Insulation to be placed in accordance per the required min. R-values as determined in the current International Energy Conservation Code.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 - 2. Unfaced units to be used as per ASHRAE recommendations for the corresponding hygro-thermal region.
- D. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 4. For wood-framed construction, install mineral-fiber blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

- E. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 - 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
- F. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.5 INSTALLATION OF VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Before installing vapor retarder, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
- C. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.
- F. Vapor retarder (type) to be placed in wall assembly in accordance with ASHRAE requirements for the appropriate hygro-thermal region.

3.6 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

SECTION 07241 - EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. This document is to be used in preparing specifications for an Exterior Insulation and Finish System (EIFS) with Moisture Drainage including:
 - a. An integral fluid applied air and water-resistive membrane barrier compatible with the substrate surface and adhesive application of the EIF system.
 - b. Accessory materials required for treating sheathing joints, fasteners, penetrations, rough openings, and material transitions compatible with substrate surfaces and the adhesive application of the EIF system.
 - c. Joint sealants compatible with specified EIFS for use in all exterior envelope joint waterproofing.
 - d. A comprehensive single source limited EIF system warranty inclusive of EIFS, fluid applied air and water-resistive membrane barrier, accessory materials, and sealants.
- B. Related Requirements:
 - 1. Section 03300 Cast-In-Place Concrete
 - 2. Section 04200 Unit Masonry
 - 3. Section 06100 Rough Carpentry
 - 4. Section 06160 Sheathing
 - 5. Section 07271 Air/Moisture Barriers
 - 6. Section 07620 Sheet Metal Flashing and Trim
 - 7. Section 07900 Joint Sealants
 - 8. Section 08410 Aluminum Framed Entrances and Storefronts

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM Standards:
 - a. ASTM B 117 Standard Practice for Operating Salt Spray (Fog) Apparatus
 - b. ASTM C 67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
 - c. ASTM C 150 Standard Specification for Portland Cement
 - d. ASTM C 297 Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
 - e. ASTM C 510 Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants
 - f. ASTM C 518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - g. ASTM C 639 Standard Test Method for Rheological (Flow) Properties of Elastomeric Sealants
 - h. ASTM C 661 Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
 - i. ASTM C 679 Standard Test Method for Tack-Free Time of Elastomeric Sealants
 - j. ASTM C 719 Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)1, 2
 - k. ASTM C 793 Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants
 - l. ASTM C 794 Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
 - m. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
 - n. ASTM C 1063 Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement Plaster.
 - o. ASTM C 1184 Standard Specification for Elastomeric Joint Sealants

- p. ASTM C 1246 Standard Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants After Cure
- q. ASTM C 1248 Standard Test Method for Staining of Porous Substrate by Joint Sealants
- r. ASTM C 1305 Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane
- s. ASTM C 1382 Standard Test Method for Determining Tensile Adhesion Properties of Sealants When Used in Exterior Insulation and Finish Systems (EIFS) Joints
- t. ASTM C 1397 Standard Practice for Application of Class PB Exterior Insulation and Finish System (EIFS) and EIFS with Drainage
- u. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- v. ASTM D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
- w. ASTM D 968 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
- x. ASTM D 1784 Standard Specification for Rigid PVC and CPVC Compounds
- y. ASTM D 1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
- z. ASTM D 2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
- aa. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- bb. ASTM D 3330 Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape
- cc. ASTM D 4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- dd. ASTM D 4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- ee. ASTM E 72 Standard Methods of Conducting Strength Tests Of Panels For Building Construction
- ff. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
- gg. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
- hh. ASTM E 119 Standard Method for Fire Tests of Building Construction and Materials
- ii. ASTM E 283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
- jj. ASTM E 330 Test Method for Structural Performance of Exterior Windows, Doors and Curtain Walls by Uniform Static Air Pressure Difference
- kk. ASTM E 331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
- ll. ASTM E 831 Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis
- mm. ASTM E1233 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential
- nn. ASTM E 2098 Test Method for Determining the Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to Sodium Hydroxide Solution
- oo. ASTM E 2134 Test Method for Evaluating the Tensile-Adhesion Performance of Exterior Insulation and Finish Systems (EIFS)
- pp. ASTM E 2178 Standard Test Method for Air Permeance of Building Materials
- qq. ASTM E 2273 Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies
- rr. ASTM E 2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- ss. ASTM E 2430 Standard Specification for Expanded Polystyrene (EPS) Thermal Insulation Boards for use in Exterior Insulation and Finish Systems (EIFS)

- tt. ASTM E 2485 Standard Test Method for Freeze-Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water-Resistive Barrier Coatings
- uu. ASTM E 2486 Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
- vv. ASTM E 2568 Standard Specification for PB Exterior Insulation and Finish Systems
- ww. ASTM E 2570 Standard Test Method for Evaluating Water-Resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage
- 2. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 268 Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Source
 - b. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components
- 3. The American Association of Textile Chemists and Colorists:
 - a. AATCC 127-08 Water Resistance: Hydrostatic Pressure Test
- 4. US Federal Specifications
 - a. TT-S-001543A Sealing Compound: Silicone Rubber Base (for Calking, Sealing, and Glazing in Buildi
 - b. 3ngs and Other Structures)
 - c. TT-S-00230 Sealing Compound: Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate for related specification and integration of Selected Materials as referenced in Section 2.02.B.1, 2.02.B.2 and 2.02.C herein below.
- B. Sequencing
 - 1. Provide jobsite grading prior to installation of Exterior Insulation and Finish System with Moisture Drainage so that the system may be terminated at 8 in above grade or as required by code.
 - 2. Coordinate installation of sheathing board and accessory materials, flashing, foundation waterproofing, roofing membrane, windows, doors, and other penetrations of the exterior walls to provide a continuous air and water-resistive membrane barrier.
 - 3. Provide protection of rough openings before installing windows, doors, and other penetrations of the exterior walls.
 - 4. Coordinate installation of windows and doors so air and water-resistive membrane barrier accessory materials, transitions, flashings, etc. are connected to them to provide a continuous barrier.
 - 5. Install window and door head flashings immediately after windows and doors are installed.
 - 6. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.
 - 7. Install copings and sealants immediately after installation of the Exterior Insulation and Finish System with Moisture Drainage and when EIFS coatings are dry.
 - 8. Attach penetrations through Exterior Insulation and Finish System to structural support and provide water-tight seals at penetrations.

1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

- A. Submit product data as required by Section 01 33 00, Administrative Requirements.
- B. Submit shop drawings for panelized EIFS with Moisture Drainage showing wall layout, connections, details, expansion joints, and installation sequence.
- C. Submit two (2) samples of the Exterior Insulation and Finish System with Moisture Drainage for each finish, texture, and color to be used on the project. Use the same tools and techniques proposed for the actual installation. Make the samples of sufficient size to accurately represent each color and texture being utilized on the project.

- D. Submit a current copy of the manufacturer's Trained Contractor Certificate for the EIF system specified.
- E. Submit Owner/Architect-requested test results verifying the performance of the Exterior Insulation and Finish System with Moisture Drainage.
- F. Submit a copy of the manufacturer's installation details and application instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Submit a copy of the manufacturer's recommended maintenance and repair manual.
- B. Submit a copy of the Exterior Insulation and Finish System with Moisture Drainage manufacturer's comprehensive single source limited warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. A member in good standing of the EIFS Industry Members Association (EIMA).
 - 2. Manufacture Exterior Insulation and Finish System with Moisture Drainage materials at a facility covered by a current ISO 9001:2015 and ISO 14001:2015 certification. Certification of the facility is done by a registrar accredited by the American National Standards Institute, Registrar Accreditation Board (ANSI-RAB).
- B. Contractor Qualifications:
 - 1. Knowledgeable in the proper installation of the Exterior Insulation and Finish System with Moisture Drainage.
 - 2. Possess a current copy of the manufacturer's Trained Contractor Certificate for the EIF system specified.
 - 3. Successfully complete a minimum of three (3) projects of similar scope and scale to the specified project.
- C. Insulation Board Manufacturer Qualifications:
 - 1. Listed by EIFS Manufacturer, and capable of producing the Expanded Polystyrene (EPS) in accordance with the current EIFS Manufacturer's Specification for Insulation Board.
 - 2. Subscribe to the Dryvit Third Party Certification and Quality Assurance Program.
- D. Panel Fabricator Qualifications:
 - 1. Experienced and competent in the fabrication of architectural wall panels.
 - 2. Possess a current Outsulation Plus MD System Trained Contractor Certificate* issued by Dryvit Systems, Inc.
- E. Panel Erector Qualifications:
 - 1. Experienced and competent in the installation of architectural wall panel EIF systems.
 - 2. Shall be:
 - a. The panel fabricator or
 - b. An erector approved by the panel fabricator or
 - c. An erector under the direct supervision of the panel fabricator.
- F. Mock-Up:
 - 1. Provide the owner/architect with a mock-up for approval.
 - a. Of suitable size as required to accurately represent the products being installed, as well as each color and texture to be utilized on the project.
 - b. Prepared with the same products, tools, equipment and techniques required for the actual applications. Use finish from the same batch that is being used on the project.
 - c. Available and maintained at the jobsite.
- G. Regulatory Requirements:
 - 1. Separate the EPS insulation board from the interior of the building by a minimum 15-minute thermal barrier.
 - 2. Comply with local building codes for the use and maximum thickness of EPS insulation board.
- H. Inspections:
 - 1. Cooperate with independent, third-party inspectors when required by code or by contract documents.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver all Exterior Insulation and Finish System with Moisture Drainage components and materials to the job site in the original, unopened packages with labels intact.
- B. Inspect all Exterior Insulation and Finish System with Moisture Drainage components and materials upon arrival for physical damage, freezing or overheating. Do not use questionable materials.
- C. Store all Exterior Insulation and Finish System with Moisture Drainage components and materials at the jobsite in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Maintain minimum and maximum storage temperature as stated in the product data sheets or specifications for the materials selected. NOTE: Minimize exposure of materials to temperatures over 90 °F (32 °C). Finishes exposed to temperatures over the published maximum storage temperature for even short periods may exhibit skinning and increased viscosity and should be inspected prior to use.
- D. Protect all products from inclement weather and direct sunlight.

1.8 SITE CONDITIONS

- A. Ambient Conditions
 - 1. Do not apply wet materials during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
 - 2. Verify the minimum air and wall surface temperatures at the time of application as stated in the product data sheets or specifications for the materials selected.
 - 3. Maintain these temperatures with adequate air ventilation and circulation for a minimum of 24 hours (48 hours for specific Specialty Finishes) thereafter, or until the products are completely dry.

1.9 WARRANTY

- A. Manufacturers' Limited EIF System Warranty
 - 1. Manufacturer shall offer a limited material defect and labor to repair or replace defective material warranty stating the Products will be free from manufacturing defect and will perform as warranted in the manner specified for the stated term measured from the Date of Project Substantial Completion.
 - a. A pre-construction meeting, including representatives of the Manufacturer, the Applicator, the Owner, and the Consultant (if applicable), shall be required prior to installation of the Products.
 - b. The term of this warranty may be extended for an additional 2 years with involvement on the project of a Manufacturer-approved, third-party consultant ("Consultant") engaged by the Owner or its authorized representative, at the Owner's sole expense. Inspection reports generated by the Consultant shall be made available to the Manufacturer and the Owner.
 - c. The warranty is available upon written request.
 - 2. The EIF system warranty shall additionally include the following for the term of the warranty or as specifically noted hereunder.
 - a. The EIF system warranty term shall be 10 years.
 - b. The EIFS will remain in a watertight condition when the EIFS is used in conjunction with approved Company Joinery and Sealants.
 - c. The EIFS will drain incidental moisture between the air/water-resistive barrier and the insulation board.
 - 1) Remedy includes repair or replacement of any sheathing or framing member that is damaged as a result of the EIF system failing to drain incidental moisture between the secondary weather barrier and the insulation board.
 - d. Finish will be UV fade resistant for 10 years, except for specially produced colors.
 - 1) Specially produced colors will be UV fade resistant for 5 years when high-performance colorants are used to formulate.
 - e. The EIFS shall be eligible to receive a renewal of the original warranty if the Owner satisfactorily completes the specific renovation requirements published by the Manufacturer.
- B. Installer Warranty

1. EIF system Installer shall provide a separate minimum 1-year warranty for all workmanship related to the proper installation and drainage performance of the EIFS application. Manufacturer shall not be responsible for workmanship associated with the installation of Exterior Insulation and Finish System with Moisture Drainage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers List:
 1. Dryvit Systems, Inc., One Energy Way, West Warwick, RI 02893, 800-556-7752, www.dryvit.com.
 2. Tremco, Inc., 3735 Green Road Beachwood, OH 44122 800.321.7906, www.tremco.com.
- B. Substitution Limitations:
 1. All components of the Outsulation® Plus MD System® including EPS Insulation Board shall be supplied or obtained from Dryvit Systems, Inc., Tremco, Inc. or their authorized distributors. Substitutions or additions of materials manufactured or supplied by others will void the EIF system warranty.
 2. Alternate EIFS manufacturers must demonstrate equivalency for all elements of EIF system such as but not limited to:
 - a. Material components, compatibility and testing
 - b. Standard and specialty finishes;
 - c. Color and texture matching; and,
 - d. Warranty criteria as specified herein.
 3. Submit alternate EIFS manufacturer's complete data highlighting equivalency for review through Substitution Requirements as defined in Division 1.

2.2 DESCRIPTION

- A. System Description:
 1. The Dryvit Outsulation Plus MD System is an Exterior Insulation and Finish System (EIFS) with Moisture Drainage, consisting of:
 - a. An Air and Water-Resistive Membrane Barrier
 - b. Accessory Materials
 - c. Adhesive – installed in vertical ribbons to facilitate egress of incidental moisture
 - d. Expanded Polystyrene (EPS) insulation board
 - e. Base Coat
 - f. Reinforcing Mesh
 - g. Finish Coat
 - h. Joint Sealants as specified herein below
- B. Materials:
 1. Air and Water-Resistive Barrier:
 - a. Refer to Section 07271.
 2. Drainage Components:
 - a. Drainage Track UV treated PVC "J" channel perforated with weep holes, complying with ASTM D 1784 and ASTM C 1063. (Note: The use of Dryvit Drainage Track is limited to the base of the EIF system at finished grade level. Use Dryvit Drainage Strip at all other horizontal terminations.)
 - b. Acceptable manufacturers of Drainage Track:
 - 1) Starter Trac STWP – without drip edge by Plastic Components, Inc.
 - 2) Starter Trac STDE – with drip edge by Plastic Components, Inc.
 - 3) Universal Starter Track by Wind-lock Corporation
 - 4) Sloped Starter Strip with Drip by Vinyl Corp.
 - c. Dryvit Drainage Strip™ corrugated plastic strip.
 - d. Dryvit TREMGrip™ urethane-based adhesive used to attach Drainage Track and Dryvit Drainage Strip to the sheathing.
 3. Adhesives:

- a. Liquid polymer-based adhesive field mixed with Portland cement.
 - 1) Dryvit Primus®
 - 2) Dryvit Genesis®
- b. Ready mixed dry blend cementitious, copolymer-based adhesive field mixed with water.
 - 1) Dryvit Primus® DM
 - 2) Dryvit Genesis® DM
 - 3) Dryvit Genesis® DMS
 - 4) Rapidry DM™ 35-50
 - 5) Rapidry DM™ 50-75
4. Insulation Board:
 - a. Expanded Polystyrene; minimum thickness 25 mm (1 in); meeting Dryvit Specification DS131 and ASTM E 2430.
5. Pre-Coated Insulation Starter Boards, Corners and Shapes:
 - a. Machine Coated Starter Boards, Corners and Shapes: Shall be produced with materials approved by Dryvit Systems, Inc. and be supplied by a fabricator approved by Dryvit Systems, Inc.
6. Base Coat:
 - a. Liquid polymer-based base coat field mixed with Portland cement.
 - 1) Dryvit Primus
 - 2) Dryvit Genesis
 - 3) Dryvit Dryflex
 - b. Ready mixed dry blend cementitious, copolymer-based base coat field mixed with water.
 - 1) Dryvit Primus DM
 - 2) Dryvit Genesis DM
 - 3) Dryvit Genesis DMS
 - 4) Rapidry DM 35-50
 - 5) Rapidry DM 50-75
 - 6) Dryvit NCB – Non-cementitious
 - c. Liquid polymer-based base coat field mixed with Portland cement when specified.
 - 1) ShieldIt™
7. Reinforcing Mesh:
 - a. Open-weave, glass fiber fabric treated for compatibility with other EIF system materials.
 - b. Provide for ultra high impact mesh assembly including Panzer 15 mesh for all EIFS clad wall areas within 8'-0" of grade and where additionally indicated on contract drawings.

Reinforcing Mesh1/Weight oz/yd ² (g/m ²)	Minimum Tensile Strengths	EIMA Impact Classification	EIMA Impact Range in-lbs (Joules)		Impact Test Results in-lbs (Joules)	
Standard - 4.3 (146)	150 lbs/in (27 g/cm)	Standard	25-49	(3-6)	36	(4)
Standard Plus - 6 (203)	200 lbs/in (36 g/cm)	Medium	50-89	(6-10)	56	(6)
Intermediate™ - 12 (407)	300 lbs/in (54 g/cm)	High	90-150	(10-17)	108	(12)
Panzer 151 - 15 (509)	400 lbs/in (71 g/cm)	Ultra High	>150	(>17)	162	(18)
Panzer 201 - 20.5 (695)	550 lbs/in (98 g/cm)	Ultra High	>150	(>17)	352	(40)
Detail Mesh Short Rolls - 4.3 (146)	150 lbs/in (27 g/cm)	n/a	n/a	n/a	n/a	n/a
Corner Mesh™ - 7.2 (244)	274 lbs/in (49 g/cm)	n/a	n/a	n/a	n/a	n/a
* It shall be colored blue and bear the Dryvit logo for product identification						
1. Shall be used in conjunction with Standard Mesh (recommended for areas exposed to high traffic)						

8. Finish:
 - a. Water-based, acrylic coating with integral color and texture; formulated with Dirt Pickup Resistance (DPR) chemistry.

- 1) Available textures:
 - (a). Sandpebble® Fine – fine pebble texture
- C. Joint Sealants:
 1. Silicone Sealant:
 - a. Tremco Spectrem 1: An ultra low modulus, high-performance, one-part, moisture-curing silicone joint sealant with physical properties making it an ideal sealant for sealing dynamic joints.
 - b. Tremco Spectrem 3: A general-purpose, low-modulus, high performance, one-part, neutral-cure, non-staining, low dirt pickup, construction-grade silicone sealant.
 - c. Tremco Spectrem 4-TS: A multi-component, neutral-curing, non-staining, low dirt pick up, low-modulus silicone sealant specially formulated for use in dynamically moving building joints. Spectrem 4-TS offers color flexibility with the opportunity to tint the material on site.
 - 1) Coordination for custom sealant colors is required.
 - d. Where deemed necessary, use TREMPprime Silicone Porous Primer.
 - e. See related specification section or consult with Tremco, Inc. for more information.
- D. Jobsite-Mixed Materials:
 1. Portland cement: verify is Type I, II or 1L, meeting ASTM C 150, white or gray in color, fresh and free of lumps.
 2. Water: verify is clean and free of foreign matter.
- E. Reference Documentation for Outsulation Plus MD System:
 1. Data Sheet – DS929
 2. Details – DS944
 3. Application Instructions – DS934

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Verify access to electric power, clean water and a clean work area at the location where the Dryvit materials are to be applied.
 2. Verify the deflection of the substrate does not exceed 1/240 times the span. Verify substrate is flat within 1/4 in (6.4 mm) in a 4 ft (1.2 m) radius.
 3. Verify substrate is sound, dry, connections are tight; has no surface voids, projections, or other conditions that may interfere with the Exterior Insulation and Finish System with moisture drainage installation or performance.
 4. Verify the slope of inclined surfaces are not less than 6:12 (27 o) were the length of the slope does not exceed 12 in (305 mm) or 3:12 (14 o) were the length of the slope does not exceed 4 in (102 mm).
 5. Verify metal roof flashings have been installed in accordance with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards.
 6. Verify all rough openings are flashed in accordance with the Exterior Insulation and Finish System with Moisture Drainage manufacturer's installation details, or as otherwise necessary to prevent water penetration. Verify chimneys, balconies and decks have been properly flashed as necessary to prevent water penetration.
 7. Verify windows and doors are installed and flashed per manufacturer's requirements and installation details.
 8. Notify general contractor of all discrepancies prior to the installation of the Exterior Insulation and Finish System with moisture drainage.
 9. Verify that expansion joints are installed:
 - a. Where expansion joints occur in the substrate system.
 - b. Where building expansion joints occur.
 - c. At floor lines in wood frame construction.
 - d. At floor lines of non-wood framed buildings where significant movement is expected.

- e. Where the Exterior Insulation and Finish System with moisture drainage abuts dissimilar materials.
 - f. Where the substrate type changes.
 - g. Where prefabricated panels abut one another.
 - h. In continuous elevations at intervals not exceeding 75 ft (23 m).
 - i. Where significant structural movement occurs, such as changes in roof line, building shape or structural system.
10. Vapor Retarders: The use and location of vapor retarders within a wall assembly is the responsibility of the project designer and shall comply with local building code requirements. The type and location shall be noted on the project drawings and specifications. Vapor retarders may be inappropriate in certain climates and can result in condensation within the wall assembly.

3.2 PREPARATION

- A. Protect the Exterior Insulation and Finish System with Moisture Drainage materials by permanent or temporary means from inclement weather and other sources of damage prior to, during, and following application until completely dry.
- B. Protect adjoining work and property during installation of the Exterior Insulation and Finish System with Moisture Drainage.
- C. Prepare the substrate to be free of foreign materials, such as oil, dust, dirt, form-release agents, efflorescence, paint, wax, water repellants, moisture, frost, and any other condition that may inhibit adhesion.

3.3 INSTALLATION

- A. Install the EIF system in accordance with ASTM C1397 and the Dryvit Outsulation Plus MD System Application Instructions, DS934. Apply base coat sufficient to fully embed the reinforcing mesh. The recommended method is to apply the base coat in two (2) passes.
- B. Apply sealant to base coat surface prepared in accordance with DS153.
- C. Install high impact reinforcing mesh as specified at ground level, high traffic areas and other areas exposed to or susceptible to impact damage as designated on contract drawings.
- D. Install Machine Coated Dryvit EPS Shapes in accordance with Dryvit Publication DS854.

3.4 SITE QUALITY CONTROL

- A. Exterior Insulation and Finish System with Moisture Drainage manufacturer assumes no responsibility for on-site inspections or application of its products.
- B. EIFS sub-contractor to certify in writing the quality of work performed relative to the substrate system, details, installation procedures, and as to the specific products used.
- C. EPS supplier, if requested, to certify in writing that the EPS meets the Exterior Insulation and Finish System with Moisture Drainage manufacturer's specifications.
- D. The sealant contractor, if requested, to certify in writing that the sealant application is in accordance with the sealant manufacturer's and the Exterior Insulation and Finish System with Moisture Drainage manufacturer's recommendations.

3.5 CLEANING

- A. Remove all excess Exterior Insulation and Finish System materials from the job site by the contractor in accordance with contract provisions and as required by applicable law.
- B. Leave all surrounding areas, where the Exterior Insulation and Finish System with Moisture Drainage has been applied, free of debris and foreign substances resulting from the EIFS sub-contractor's work.

SECTION 07261 – UNDERSLAB VAPOR BARRIER**PART 1- GENERAL****1.0 DESCRIPTION OF WORK**

- A. Vapor barrier to be placed under interior concrete slabs on grade where indicated.

1.1 REFERENCE STANDARDS

- A. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials, 2005.
- B. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2009.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Product Data: Submit manufacturer's product literature and instructions for vapor barrier material and mastic.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's original packaging or containers.
- B. Store to prevent damage, deterioration or contamination.

PART 2- PRODUCTS**2.0 VAPOR BARRIER:**

- A. Acceptable Manufacturer:
 - 1. Poly-America: Husky Yellow Guard.
 - 2. Or Owner approved equal.
- B. Requirements:
 - 1. Permeance of less than 0.01 perms as tested in accordance with AST.
 - 2. Strength: Class A requirements of ASTM E 1745.
 - 3. Minimum Thickness: 20 mil.
- C. Adhesive or Tape: Acceptable to manufacturer of vapor barrier material.

PART 3- EXECUTION**3.0 INSTALLATION:**

- A. Install vapor barrier over compacted, clean subgrade material, free of debris and protrusions.
- B. Lay vapor barrier over interior building area to receive concrete slab; lap edges 6" minimum and seal with manufacturer's tape. Lay membrane with seams perpendicular to and lapped in direction of pour. Turn edges of membrane up to within 1/2" of top of slab at intersection with vertical surfaces.
- C. Where expansion or contraction joints are indicated in slab, lay vapor barrier continuous under joint fill.
- D. Seal openings in vapor barrier around pipes and other protrusions per manufacturer's instructions. Fold at corners to form envelopes.
- E. Protect vapor barrier installation from damage until concrete slab is in place.

SECTION 07271 – AIR / MOISTURE BARRIER**PART 1 GENERAL****1.1 SUMMARY**

- A. Section includes fluid-applied, vapor-permeable membrane air barriers.

1.2 RELATED REQUIREMENTS

1. Section 04200 Unit Masonry for compatibility with flashing components.
2. Section 04241 Thin Brick Veneer System and Section 04251 Thin Brick Veneer Support System for compatibility with flashing components.
3. Section 06160 Sheathing for air barrier substrates.
4. Division 07 roofing Sections for roof assembly air barriers and interface coordination.
5. Division 08 exterior openings sections for framing for aluminum-framed entrances and storefronts receiving air barrier transition assembly specified in this Section.

1.3 REFERENCES

- A. References, General: Versions of the cited standards current as of the date of issue of the project apply to the Work of this Section.
- B. ASTM International (ASTM): www.astm.org:
1. ASTM A 240/A 240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 2. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
 3. ASTM C 1193 - Guide for Use of Joint Sealants
 4. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
 5. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
 6. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials
 7. ASTM E 162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
 8. ASTM E 783 - Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors
 9. ASTM E 1186 - Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
 10. ASTM E 2178 - Standard Test Method for Air Permeance of Building Materials
 11. ASTM E 2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- C. California Department of Public Health: www.cdph.ca.gov
1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.
- D. U. S. Environmental Protection Agency (EPA): www.epa.gov:
1. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.
- B. Preinstallation Conference: Conduct conference at Project Site.
1. Review requirements for air barrier products and installation, project and manufacturer's details, mockups, testing and inspection requirements, and coordination and sequencing of air barrier work with work of other Sections.

2. Review manufacturer's instructions for air barrier application meeting Project requirements for substrates specified, including three-dimensional video model demonstrating proper application of components at wall openings.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of air barrier product specified, including:
 1. Technical data indicating compliance with requirements.
 2. Substrate preparation instructions and recommendations.
- B. Shop Drawings: Show locations for air barrier. Show details for each type of substrate, joints, and edge conditions, including flashings, counterflashings, penetrations, transitions, and terminations.
 1. Show location of transition and accessory materials providing connectivity throughout the assemblies.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
 1. Certification of manufacturer's approval of Installer.
- B. Manufacturer's Product Compatibility Certificate: Certify compatibility of air barrier products with adjacent materials.
- C. Low-Emitting Product Certificate: For air barrier products specified to meet volatile organic emissions standards, submit Greenguard Children and Schools Certification or comparable certification acceptable to Architect.
- D. Product Test Reports: Test data for air barrier products and air barrier assembly, by qualified testing agency, indicating proposed membrane air barrier meets performance requirements, when requested by Architect.
- E. Warranty: Sample of unexecuted manufacturer and installer special warranties.
- F. Field quality control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm with minimum three years experience in installation of specified products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years experience installing similar work, able to communicate verbally with Contractor, Architect, and employees.
- B. Manufacturer Qualifications: A qualified manufacturer listed in this Section with minimum five years experience in manufacture of air barrier membrane as one of its principal products.
 1. Manufacturer's product submitted has been in satisfactory operation on five similar installations for at least five years.
 2. Approval of Manufacturers and Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
 - a. Completed and signed Substitution Request form.
 - b. Product data, including certified independent test data indicating compliance with requirements.
 - c. Sample shop drawings from similar project.
 - d. Project references: Minimum of five installations of similar system not less than five years old, with Owner and Architect contact information.
 - e. Certificate of ABAA accreditation if required for Project.
 - f. Sample warranty.
- C. Air Barrier Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified air barrier system, qualified to perform observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Inspector shall be one of the following:
 1. An authorized full-time technical employee of the manufacturer.
 2. A independent party certified as an air barrier inspector by the ABAA or other certifying organization acceptable to Architect, retained by the Contractor.

- D. Mockups: Provide air barrier mockup application within mockups required in other sections, or if not specified, in an area of not less than 150 sq. ft. (14 sq. m) of wall surface where directed by Architect for each type of backup wall construction. Include examples of surface preparation, crack and joint treatment, air barrier application, and flashing, transition, and termination conditions, to set quality standards for execution.

1. Include intersection of wall air barrier with roof air barrier and with foundation wall intersection.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Accept materials on site in manufacturer's unopened original packaging.
- B. Store products in weather protected environment, clear of ground and moisture, within temperature ranges recommended by air barrier manufacturer.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.10 SCHEDULING

- A. Coordinate installation of membrane air barrier with completion of roofing and other work requiring interface with air barrier.
- B. Schedule work so air barrier applications may be inspected prior to concealment.
- C. Ensure air barrier materials are cured before covering with other materials.

1.11 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which air barrier manufacturer agrees to furnish and install air barrier material to repair or replace those materials installed according to manufacturer's written instructions that exhibit material defects or otherwise fail to perform as specified under normal use within warranty period specified.
 1. Access for Repair: Owner shall provide unimpeded access to the Project and the air barrier system for purposes of testing, leak investigation, and repair, and shall reinstall removed cladding materials upon completion of repair.
 2. Cost Limitation: Manufacturer's obligation for repair or replacement shall be limited to the original installed cost of the work.
 3. Warranty Period: 35 years date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of air barrier materials from the following:
 1. Movement of the structure caused by structural settlement or stresses on the air barrier exceeding manufacturer's written specifications for elongation.
 2. Mechanical damage caused by outside agents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Products: Provide air barrier products manufactured by Tremco, Inc., Commercial Sealants and Waterproofing Division, An RPM Company, Beachwood OH; (866) 321-6357; email: techresources@tremcoinc.com; www.tremcosealants.com, or comparable products of other manufacturer approved by Architect in accordance with Instructions to Bidders and Division 01 General Requirements.

2.2 MATERIALS, GENERAL

- A. Source Limitations: Obtain air-barrier materials from single source from single manufacturer.

2.3 PERFORMANCE REQUIREMENTS

- A. General: Membrane air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Membrane air barriers shall accommodate substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without moisture deterioration and air leakage exceeding performance requirements.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.
- C. Specifier: Retain "Fire Propagation Characteristics" Paragraph if air barrier is part of a wall assembly required to comply with NFPA 285.
- D. Fire Propagation Characteristics: Provide air barrier system qualified as a component of a comparable wall assembly that has been tested and passed NFPA 285.

2.4 MEMBRANE AIR BARRIER

- A. A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, UV-resistant, synthetic membrane, formulated for application in a range of 48 - 70 mils (wet), 25 - 35 mils (dry)
 - 1. Basis of Design Product: Tremco, Inc., ExoAir 230.
 - 2. Air Permeance, ASTM E 2178: 0.004 cfm/sq. ft of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference, maximum.
 - 3. Vapor Permeance, ASTM E 96/E96M: Minimum 12 perms (690 ng/Pa x s x sq. m).
 - 4. Elongation, Ultimate, ASTM D 412, Die C: 600 percent, minimum.
 - 5. Combustion Characteristics: Class A, flame spread, not greater than 25; smoke developed, not greater than 450, per ASTM E 84.
 - 6. UV Resistance, QUV-B: Over 160 cycles of UV and water spray with no observable deterioration.
 - 7. VOC Content: Less than 50 g/L.

2.5 ACCESSORY MATERIALS

- A. General: Accessory materials as described in manufacturer's written installation instructions, recommended to produce complete air barrier assembly meeting performance requirements, and compatible with air barrier membrane material and adjacent materials.
- B. Primer: Liquid primer meeting VOC limitations, recommended for substrate by membrane air barrier manufacturer, when installing modified bituminous self-adhered membranes.
 - 1. Basis of Design Product: Tremco, Inc., ExoAir Primer
- C. Transitions:
 - 1. Counterflashing Strip: Modified bituminous, 40 mils (1.0 mm) thick self-adhering composite sheet consisting of 32 mils (0.8 mm) of SBS rubberized asphalt laminated to an 8 mils (0.2 mm) high-density, cross-laminated polyethylene film, for counterflashing of metal flashings and for substrate transitions and for termination of air barrier to bituminous roof membranes and to air barrier terminations at openings.
 - a. Basis of Design Product: Tremco, Inc., ExoAir TWF Thru-Wall Flashing.
 - 2. High Temperature Flashing Strip and Underlayment: Butyl, 24 mil thick self-adhering composite sheet consisting of 20 mils of butyl laminated to 4 mil polyethylene film; thermally stable under intermittent, non-continuous exposure up to 240 deg F (115 deg C).
 - a. Basis of Design Product: Tremco, Inc., ExoAir 110AT.
 - 3. Flashing Strip: Butyl, 22 mil thick self-adhering composite sheet consisting of 16 mils of butyl laminated to 6 mil polypropylene film; thermally stable under intermittent, non-continuous exposure up to 240 deg F (115 deg C)

4. Opening Transition Assembly: Cured low-modulus silicone extrusion, with reinforcing ribs, sized to fit opening widths, with the following characteristics:
 - a. Basis of Design Product: Tremco, Inc., Proglaze ETA Engineered Transition Assembly. Tear Strength: 110 lb/in (19.3 kN/m)
5. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with manufacturer's recommended silicone sealant for bonding extrusions to substrates.
 - a. Basis of Design Product: Tremco, Inc.; Spectrem SimpleSeal.
- D. Reinforcing Fabric: High strength mesh fabric consisting of open-weave glass fiber saturated with synthetic resins formulated for high moisture resistance, for reinforcing of liquid applications; not less than 2.5 oz/sq. yd (85 g/sq. m).
 1. Basis of Design Product: Tremco, Inc., Tremco 2011.
- E. Liquid Joint Sealants:
 1. ASTM C 920, single-component polyurethane, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories.
 - a. Basis of Design Product: Tremco, Inc., Dymonic 100.
 2. ASTM C 920, single-component, neutral-curing silicone, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories post installation of the membrane.
 - a. Basis of Design Product: Tremco, Inc., Spectrem 1.
- F. Sprayed Polyurethane Foam Sealant: Sprayed Polyurethane Foam Sealant: Foamed-in-place, 1.5- to 2.0-lb/cu. ft. (24- to 32-kg/cu. m) density, with flame-spread index of 25 or less per ASTM E 162, for filling of gaps at openings and penetrations.
 1. Basis of Design; Tremco Inc., Flexible Low Expanding Foam (LEF)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Surface Condition: Before applying air barrier materials, examine substrate and conditions to ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion, and conditions comply with manufacturer's written recommendations.
 1. Verify concrete and masonry surfaces are visibly dry, have cured for time period recommended by membrane air barrier manufacturer, and are free from release agents, curing agents, and other contaminants.
 2. Test for capillary moisture by method recommended in writing by air barrier manufacturer.
 3. Verify masonry joints are filled with mortar and struck flush.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INTERFACE WITH OTHER WORK

- A. Commencement of Work: Commence work once air barrier substrates are adequately protected from weather and will remain protected during remainder of construction.
- B. Sequencing of Work: Coordinate sequencing of air barrier work with work of other sections that form portions of building envelope air barrier to ensure that flashings and transition materials can be properly installed and inspected. Roofing systems shall be capped and sealed, or top of walls protected, in such a way as to eliminate the ability of water to saturate the wall or interior space, both before and after, air barrier system installation. Coordinate installation of EXOAIR® 230 with the roofing trade to ensure compatibility and continuity with the roofing system.
- C. Subsequent Work: Coordinate air barrier work with work of other sections installed subsequent to air barrier to ensure complete inspection of installed air barrier and sealing of air barrier penetrations necessitated by subsequent work.

3.3 PREPARATION

- A. Clean, prepare, and treat substrate in accordance with air barrier manufacturer's written instructions.
 - 1. Mask adjacent finished surfaces.
 - 2. Remove contaminants and film-forming coatings from substrates.
 - 3. Remove projections and excess materials and fill voids with substrate patching material.
 - 4. Prepare and treat joints and cracks in substrate per ASTM C 1193 and membrane air barrier manufacturer's written instructions.

3.4 APPLICATION OF ACCESSORY MATERIALS

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions. Install transition materials and other accessories to form connect and seal membrane air barrier material to adjacent components of building air barrier system, including, but not limited to, roofing system air barrier, exterior fenestration systems, door framing, and other openings.
- B. Primer: Apply primer to substrates when recommended by air barrier manufacturer at required rate for those substrates that will be receiving a modified bituminous self-adhered membrane. Reprime areas not covered within 24 hours.
- C. Assembly Transitions: Connect and seal exterior wall air barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
 - 1. Opening Transitions: Fill gaps at perimeter of openings with foam sealant and apply approved transition or accessory material
 - 2. Penetrations: Fill gaps at perimeter of penetrations with foam sealant and level with approved sealant. or seal transition strips around penetrating objects and terminate with approved sealant.
 - 3. Joints: Bridge and cover isolation joints, expansion joints, and discontinuous joints between separate assemblies utilizing approved transition or accessory materials.
 - 4. Changes in Plane: Apply approved sealant beads at corners and edges to form smooth transition.
 - 5. Substrate Gaps: Cover gaps with stainless steel sheet mechanically attached to substrate and providing continuous support for air barrier.
- D. Flashings: Seal top of through-wall flashings to membrane air barrier with a continuous bead of approved sealant recommended by air barrier manufacturer.
- E. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following air barrier manufacturer's recommendations and extend repair beyond repaired areas to maintain continuity.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. General: Apply fluid air-barrier material to form a seal with transition materials and accessories to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
- B. Membrane Air Barrier: Apply fluid air barrier material in full contact with substrate to produce a continuous seal according to membrane air barrier manufacturers written instructions.
 - 1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, in a range of 25 – 35 mils (1.0 mm) dry film thickness depending on substrate, applied in one or more equal coats, roller- or spray- applied.
- C. Connect and seal exterior wall air-barrier membrane continuously to subsequently-installed roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior

louvers, exterior door framing, wall openings, and other construction used in exterior wall openings, using approved transitions and accessory materials.

- D. Wall Openings: Apply approved sealant to adhere silicone extrusion to perimeter of windows, curtain walls, storefronts, doors, and louvers. Apply [opening transition assembly] [preformed silicone sealant extrusion] according to air barrier transition manufacturer's written instructions.
- E. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following air barrier manufacturer's recommendations and extend repair beyond repaired areas to maintain continuity.
- F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency (if required by AHJ): Contractor shall engage a qualified Inspector to perform tests and inspections, including documenting of membrane air barrier prior to concealment.
 - 1. Inspections and testing shall be carried out at the following rate:
 - a. Up to 10,000 sq. ft. (930 sq. m): One inspection.
 - 2. Scope of Testing: Testing shall include the following:
 - a. Qualitative air-leakage testing per ASTM E 1186.
 - b. Quantitative air-leakage testing per ASTM E 783.
 - c. Photo documentation of work to be subsequently concealed.
- B. Coordination of Testing: Cooperate with testing agency. Allow access to work areas and staging. Notify testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection.
 - 1. Do not cover Work until testing and inspection is completed and accepted.
- C. Reporting: Forward written inspection reports to the Architect within 10 working days of the inspection and test being performed.
- D. Correction: Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.

3.7 CLEANING AND PROTECTING

- A. Clean spills, stains, and overspray resulting application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.
- B. Protect membrane air barrier from damage from subsequent work. Protect membrane materials from exposure to UV light for period in excess of that acceptable to membrane air barrier manufacturer; replace overexposed materials and retest.

SECTION 07310 - SHINGLE ROOFING**PART 1- GENERAL****1.0 SECTION INCLUDES**

- A. Granular surfaced asphalt shingle roofing, underlayment, eave, valley, and ridge protection.

1.1 RELATED SECTIONS

- A. Section 07620 - Sheet Metal Flashing and Trim.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Manufacturer's Literature: Materials description and installation instructions for system.

1.3 QUALITY ASSURANCE

- A. The installer shall be certified by the manufacturer of the roofing system, have not less than 5 years experience in the installation of roofing.
- B. The system as installed shall comply with laws, ordinances, rules and regulations of the public authorities having jurisdiction over the work.

1.4 PROJECT CONDITIONS

- A. Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations and when conditions will permit the work to proceed in accordance with requirements and the manufacturer's recommendations.
- B. Do not apply roofing materials when the roof deck is wet, and when frost, ice and snow is present on the deck. Allow surfaces to thoroughly dry before commencing work after rain, snow, and other conditions causing dampness.

1.5 WARRANTY

- A. The Contractor shall warrant the roofing system for water tightness for a period of 10 years after completion. Manufacturer's warranty shall be fully paid by the roofing contractor. Warranty shall be non-prorated and cover both labor and material, including that required to repair roof leaks. Warranty shall be signed by the contractor, roofing contractor, and manufacturer.

PART 2- PRODUCTS**2.0 ASPHALT SHINGLES**

- A. Manufacturers:
 - 1. Owens-Corning Fiberglas – Refer to exterior finishes schedule on drawings.
 - 2. Or Owner approved equal.
- B. Asphalt Shingles: ASTM D3462-87 - Mineral granule surfaced roof shingle made with glass fiber mats Dimensional shingle with a 25-Year Labor and Material Limited Warranty.

- C. Fungus Resistant: Provide shingles that have been treated to resist fungus and algae growth for a period of five years.
- D. Ice Dam Protection: If required per details, sheet barrier of rubberized asphalt bonded to sheet polyethylene, 40 mil total thickness, with strippable treated release
- E. Underlayment: Type 1, 36" wide, asphalt saturated organic felt, complying with ASTM D 226 (No. 15) or ASTM D 4869.

2.1 ACCESSORIES

- A. Nails: Standard round wire shingle nails, galvanized, 11 gauge, 3/8" heads, and of sufficient length to penetrate 1/8" through roof sheathing.
- B. Plastic Cement: Asphalt type with mineral fiber components.
- C. Ridge Vents: Subject to compliance with requirements, provide continuous ridge vents manufactured by one of the following:
 - 1. Ridge Filter Shingle vent; Air Vent, Inc.
 - 2. Ridge Filter Vent; Air Vent, Inc. (for Class A)
 - 3. Ridge Vent; Owens Corning VentSure Rigid Roll Ridge Vent.

PART 3- EXECUTION

3.0 INSTALLATION OF ICE DAM PROTECTION

- A. Place eave edge metal flashings tight with fascia boards. Weather lap joints and seal with plastic cement. Secure flange with nails.
- B. Apply rubberized asphalt/polyethylene sheet eave protection in accordance with manufacturer's instructions.
- C. When drawings indicate, extend ice dam protection membrane minimum 4 ft upslope beyond interior face of exterior wall.

3.1 INSTALLATION OF PROTECTIVE UNDERLAYMENT

- A. Place one ply of underlayment over area not protected by eave protection, with ends and edges weather lapped and nailed. Stagger end laps of each consecutive layer.
- B. Install perpendicular to slope of roof.
- C. Weather lap and seal watertight with plastic cement, items projecting through or mounted on roof.

3.2 INSTALLATION OF VALLEY PROTECTION

- A. Over the underlayment, install a 36" wide valley lines of 50 lbs. or heavier smooth surface adhesive type roll roofing or shingle underlayment, nailing only along the outer edges. Install all shingles from one side of the valley and across center line a minimum of 12". Do not nail closer than 6" to center line on each side of the valley.
- B. Extend shingles on one slope across valley and fasten. Trim shingles from other slope to achieve closed cut valley, concealing the valley protection. Nails and cement, keeping nails at least 6" away from center line.

3.3 INSTALLATION OF ASPHALT SHINGLES

- A. Install shingles in accordance with manufacturer's instructions and recommendations, but not less than those recommended by ARMA's "Residential Asphalt Roofing Manual" or the "NRCA Steep Roofing Manual."
- B. Provide double course of shingles at eaves.
- C. Place shingles in straight coursing pattern with required weather exposure to produce double thickness over full roof area.

- D. Cap hips and ridges with individual shingles, maintaining weather exposure. Place to avoid exposed nails.
- E. Complete installation to provide weather tight service.

3.4 CLEAN-UP

- A. Thoroughly remove all debris from roof, gutters, and Owner's grounds.

SECTION 07464 - ENGINEERED WOOD SIDING**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Engineered wood siding.
 - a. Panel and lap siding.
 - b. Shake siding.
 - c. Vertical siding.
 - d. Trim and fascia.
 - e. Soffit.
 - 2. Accessories.
- B. Related Requirements:
 - 1. Section 06100 "Rough Carpentry" for wood stud substrate support framing.
 - 2. Section 06160 "Sheathing" for wall sheathing substrates.
 - 3. Section 07210 "Building Thermal Insulation" for continuous insulation behind exterior cladding.
 - 4. Section 07271 "Air/Moisture Barrier" for water-resistive barriers.
 - 5. Section 07920 "Joint Sealants" for sealants at edges and transitions between composite composition siding system and exterior cladding.

1.2 DEFINITIONS

- A. Treated Engineered Wood: Engineered wood products manufactured for exterior use treated with manufacturer's proprietary process to resist fungal decay and termite damage.

1.3 COORDINATION

- A. Coordinate engineered wood siding installation with flashings, trim, and construction of other adjoining work to ensure proper sequencing, construction progress, and to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Coordinate with Section 01310 "Project Management and Coordination."
- B. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.
 - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, to attend the meeting. Advise Construction Manager of scheduled meeting dates and times a minimum of 14 days prior to meeting.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Schedule.
 - b. Responsibilities
 - c. Critical path items.
 - d. Submittals.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product and component included in engineered wood siding system. Include the following:
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product and accessory included in siding system.
 - 2. Installation methods, including nailing patterns.

3. Siding manufacturer's requirements for products to be installed by others.
4. Maintenance and periodic inspection recommendations.
- B. Shop Drawings: For engineered wood siding.
 1. Include plans, elevations, sections, and attachment details.
 2. Detail expansion joints, material joints, angle changes, flashings, and abutment to adjacent Work.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualifications: For Installer.
- B. Product Test Reports: For each product, APA tests performed by a qualified testing agency.
- C. Evaluation Reports: For engineered wood siding system, from ICC-ES in compliance with AC321.
- D. Sample warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Installers trained by siding manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components and other manufactured items so as not to be damaged or deformed. Package components for protection during transportation and handling with manufacturer's name and identification of products.
- B. Unload, store, and erect components in a manner to prevent bending, warping, twisting, and surface damage. Maintain slip sheet until piece is being prepared for installation.
- C. Store components on flat surfaces clear of the ground. Store under roof or covered with suitable weathertight and ventilated covering, and in accordance with manufacturers' written instructions.

1.10 WARRANTY

- A. Manufacturer's Trim and Siding Limited Warranty: Manufacturer agrees to repair or replace components of engineered wood siding against substrate damage within specified warranty period.
 1. Substrate damage is defined as deterioration, buckling, and overlay issues caused by manufacturing defects or termite damage.
 2. Hail damage is defined as a crack or chip in the surface overlay, or product substrate dents exceeding 3/8 inch (10 mm) in length or diameter and is caused by hail.
 3. Limited Warranty Period: 50 years from date of installation and written to Owner on date of Substantial Completion.
- B. Manufacturer's Trim and Siding Prefinish Limited Warranty: Manufacturer agrees to repair or replace components of prefinished engineered wood siding against finish and substrate damage within specified warranty period.
 1. Substrate damage is defined as deterioration, buckling, or overlay issues caused by manufacturing defects or termite damage.
 2. Hail damage is defined as cracks or chips in the surface overlay or dent in the substrate of the product that exceeds 3/8 inch (10 mm) in length or diameter, and is caused by hail.
 3. Finish damage is defined as, under normal conditions and use, discoloring due to chalking, peeling, blisters, cracks; erosion to the extent of exposing the substrate; or yellowing or color fade change from light exposure not to exceed 5 Delta E CMC (2:1).

4. Limited Warranty Period for Substrate: 50 years from date of installation and communicated to Owner on date of Substantial Completion.
5. Limited Warranty Period for Finish: 15 years from date of installation and communicated to Owner on date of Substantial Completion.
- C. Manufacturer's Accessories and Non-Standard Applications Limited Warranty: Manufacturer agrees to repair or replace components of manufacturer's accessories and when used in approved non-standard applications against substrate and finish damage within specified warranty period.
 1. Substrate damage is defined as deterioration, buckling, or overlay issues caused by manufacturing defects or termite damage.
 2. Hail damage is defined as cracks or chips in the surface overlay or dent in the substrate of the product that exceeds 3/8 inch (10 mm) in length or diameter, and is caused by hail.
 3. Finish damage is defined as, under normal conditions and use, discoloring due to chalking, peeling, blisters, cracks; erosion to the extent of exposing the substrate; or yellowing or color fade change from light exposure not to exceed 5 Delta E CMC (2:1).
 4. Limited Warranty Period for Substrate and Finish: 10 years from date of installation and communicated to Owner on date of Substantial Completion.

PART 2 PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Provide components and materials specified in this Section from single manufacturer for a complete and compatible assembly.'

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide engineered wood siding system tested to APA PS2 and PRP 108, in compliance with IBC Section 2308.9.3, Table 2308.9.3(5), and certified to be without permanent deformation or failure of structural members in accordance with design wind velocities for Project geographic location and probability of occurrence based on data from wind velocity maps provided in ASCE 7 and as approved by authorities having jurisdiction (AHJ).
 1. Design Loads: As indicated on Drawings
- B. Structural: Test in accordance with FL TAS 202 as follows:
 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Minimum test duration in accordance with FL TAS 202 is 10 seconds, which is historically U.S. practice.
 4. Test Durations: As required by design wind velocity, but not less than [10] <Insert number> seconds.
- C. Thermal Movement Performance: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

2.3 ENGINEERED WOOD SIDING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Louisiana-Pacific Corporation; LP SmartSide Trim & Siding and ExpertFinish Trim & Siding.
- B. Treated Engineered Wood Lap Siding: Exterior-grade, resin-saturated, paper overlay laminated to EPA-registered zinc-borate-treated engineered wood siding. Exposed edges sealed for moisture resistance. Manufacturer's acrylic finish.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Louisiana-Pacific Corporation; LP SmartSide Lap Siding and ExpertFinish Lap & Siding, 38 Series or comparable product.
 2. Thickness: 0.418 inch (10.6 mm) total thickness.
 3. Width: 7.84 inches (199 mm)
 4. Length: 16 ft. (4.9 m).
 5. Color: As indicated on exterior elevations.
 6. Texture: As indicated on exterior elevations.
- C. Treated Engineered Wood Trim: Provide manufacturer's standard trim, fascia board, angles, and similar components at corners, transitions, and rough openings meeting the performance requirements.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Louisiana-Pacific Corporation; LP SmartSide Trim and LP SmartSide ExpertFinish Trim, 440 Series or comparable product.
 2. Thickness: As indicated in drawings.
 3. Width: As indicated in drawings.
 4. Length: 16 ft. (4.9 m).
 5. Edges: Square.
 6. Color: As indicated on exterior elevations.
 7. Texture: As indicated on exterior elevations.
- D. Treated Engineered Wood Outside Corners: Exterior-grade, resin-saturated, paper overlay laminated to EPA-registered zinc-borate-treated engineered wood siding. Exposed edges sealed for moisture resistance. Manufacturer's acrylic primer finish.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Louisiana-Pacific Corporation; LP SmartSide Outside Corners and LP SmartSide ExpertFinish Outside Corners 540 Series or comparable product.
 2. Thickness: As indicated in drawings.
 3. Width: As indicated in drawings.
 4. Length: 10 ft. (3.0 m).
 5. Edges: Square.
 6. Color: As indicated on exterior elevations.
 7. Texture: As indicated on exterior elevations.
- E. Treated Engineered Wood J-Block: Exterior-grade, phenolic resin-saturated, paper overlay laminated to EPA-registered zinc-borate preservative-treated engineered wood siding. Exposed edges sealed for moisture resistance. Manufacturer's standard acrylic latex primer finish.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Louisiana-Pacific Corporation; LP SmartSide J-Block and LP SmartSide ExpertFinish J-Block or comparable product.
 2. Thickness: As indicated in drawings.
 3. Width: As indicated in drawings.
 4. Length: As indicated in drawings.
 5. Edges: Square.
 6. Color: As indicated on exterior elevations.
 7. Texture: As indicated on exterior elevations.
- F. Treated Engineered Wood Mini Split: Exterior-grade, resin-saturated, paper overlay laminated to EPA-registered zinc-borate-treated engineered wood siding. Exposed edges sealed for moisture resistance. Manufacturer's acrylic primer finish.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Louisiana-Pacific Corporation; LP SmartSide Mini Split and LP SmartSide ExpertFinish Mini Split or comparable product.
 2. Thickness: As indicated in drawings.
 3. Width: As indicated in drawings.
 4. Length: As indicated in drawings.
 5. Edges: Square.
 6. Color: As indicated on exterior elevations.
 7. Texture: As indicated on exterior elevations.

2.4 ACCESSORIES

- A. Fasteners: Hot-dipped galvanized nails, with 0.092-inch (2.3-mm) diameter shank, in length required to penetrate wood structural panels and structural framing a minimum of 1-1/2 inches (38 mm), as recommended in writing by composite siding system manufacturer suitable for and compatible with system materials. Larger diameter fasteners may be required depending on wind pressure, wind speed, and wind exposure category limitations for structures in product approvals PR-N124 or ESR-1301.
- B. Sealant: ASTM C920, minimum Class 25 sealant.
- C. Water-Resistive Barrier: ASTM D226 or other approved water-resistive barrier.
- D. Air Barrier:
 - 1. Refer to Section 07271 Air / Moisture Barrier
- E. Flashing:
 - 1. Provide flashing at window and door heads and where indicated on Drawings. Refer to Division 07 for sheet metal flashing.
 - 2. Material: Aluminum.
 - a. Finish: Siliconized polyester coating.
 - b. Finish: High-performance organic finish.
 - c. Finish: Factory-prime coating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, engineered wood siding system supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that support members and anchorage have been installed within alignment tolerances required by engineered wood siding manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by engineered wood siding manufacturer.
 - 3. Verify that air and moisture barrier has been installed over sheathing substrate to prevent air infiltration and water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install engineered wood siding in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Anchor engineered wood siding and other components of the Work securely in place.
 - 1. Shim or otherwise plumb substrates receiving engineered wood siding system.
 - 2. Flash engineered wood siding at perimeter of all openings.
 - 3. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 4. Seal engineered wood substrates exposed to weather to prevent moisture intrusion and water buildup.
 - a. Seal around penetrations.
 - b. Seal each exposed cut of siding and trim. It is not recommended to field spray-applied coatings on cuts.
 - c. Seal each butt joint from weather by covering with joint moldings, sealant, or factory prefinished ends.
 - 5. Install flashing and trim as engineered wood siding work proceeds.
 - 6. Align bottoms of engineered wood siding.
 - 7. Retain subparagraph below to suit Project.

8. Provide weathertight escutcheons for pipe- and conduit-penetrating engineered wood siding system.
- B. Metal Protection: Where dissimilar metal flashings contact each other or corrosive substrates, protect against galvanic action as recommended in writing by siding manufacturer.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.
 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
- E. Replace engineered wood siding components that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07464

SECTION 07545 – THERMOPLASTIC POLYOLEFIN ROOFING (TPO)**PART 1- GENERAL****1.0 SECTION INCLUDES**

- A. Single ply, fully-adhered TPO roofing system.
- B. Thermal barrier.
- C. Roof insulation for this system.
- D. Roof traffic pads.
- E. Splash blocks.

1.1 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: For roof related wood blocking and curbs.
- B. Section 07620 - Sheet Metal Flashing and Trim.
- C. Section 07720 – Roof Accessories

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Manufacturer's Literature: Materials description and installation instructions for system.
 - 2. Certification
 - a. List of at least 2 similar completed installations using the TPO roofing system specified for this project if requested by the Owner.
 - b. At completion of work, submit roofing and insulation manufacturer's certification that roofing system was installed in accordance with manufacturer's requirements.
 - 3. Test Reports: Independent testing laboratories reports stating compliance with ASTM Specifications for each type rigid polystyrene insulation.
 - a. Test reports shall be dated within 6 months of the product manufacture date.

1.3 QUALITY ASSURANCE

- A. The installer shall be certified by the manufacturer of the TPO roofing system, have not less than 5 years experience in the installation of TPO roofing.
- B. The system as installed shall comply with laws, ordinances, rules and regulations of the public authorities having jurisdiction over the work.
- C. Inspection: Upon completion of the installation, an inspection shall be made by roof membrane manufacturer's representative, to determine that the roofing system has been installed in accordance with published specifications.

1.4 PROJECT CONDITIONS

- A. Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations and when conditions will permit the work to proceed in accordance with requirements and the manufacturer's recommendations.
- B. Do not apply insulation and roofing materials when the roof deck is wet, and when frost, ice and snow is present on the deck. Allow surfaces to thoroughly dry before commencing work after rain, snow, and other conditions causing dampness.

1.5 WARRANTY

- A. The Contractor shall warrant the roofing system for water tightness for a period of **15 years** following date of completion. Manufacturer's warranty shall be fully paid by the roofing contractor. Warranty shall be non-prorated and cover both labor and material, including that required to repair roof leaks. Warranty shall be signed by the contractor, roofing contractor, and manufacturer. Final payment will not be issued until warranty is provided to Owner.
 - 1. The warranty shall include, but not be limited to, repair of leakage and the repair and/or replacement of the roofing system as necessary to correct defects or damage caused by; materials, workmanship, or wind speeds less than 72 MPH.
 - a. Materials shall include the membrane, insulation, fasteners, adhesives and tapes, flashing originally provided by the manufacturer, and all accessory products.
 - b. Repair and/or replacement of the roofing system shall include the replacement of wet insulation. For the purpose of this specification, insulation will be considered wet if either of the following exists:
 - 1) Free water is visible when the insulation is compressed.
 - 2) No free water is visible when the insulation is compressed, but the insulation is damp to the touch over a large enough area, as determined by the Director's Representative, to jeopardize the integrity of the roof system and any of its components, or to significantly lower the specified R value.

PART 2- PRODUCTS

2.0 ACCEPTABLE MANUFACTURERS

- A. For fully-adhered TPO sheet roofing membrane materials:
 - 1. Carlisle Syntec Inc. – Sure-Weld TPO Roofing System
 - 2. Firestone Building Products Co. – Ultraply TPO Roofing System
 - 3. Manville Roofing Systems Division – Ultragard TPO SRT 60.

2.1 MATERIALS

- A. TPO (Thermoplastic PolyOlefin) Membrane Roofing .060" thick conforming to the following minimum physical properties unless otherwise noted.
- B. Exposed face color: White unless otherwise noted.
 - 1. Thickness over Scrim: 0.020 inches (0.508mm).
 - 2. Breaking Strength (ASTM D 751): 250 lbf/in (1.1 kN/m) minimum.
 - 3. Tear Resistance (ASTM D 751): 55 lbf/in (245 N/M) minimum
 - 4. Elongation (ASTM D 751): 25 percent
 - 5. Sheet Dimensions, Width: 10 feet (3.05m) maximum
 - 6. Sheet Dimensions, Length: 100 feet (30.5m) maximum
- B. Flashing Material: TPO, manufacturer's standard.
- C. Molded Pipe Flashing: Manufacturer's standard.
- D. Adhesives and Sealants: Manufacturer's standard adhesive, lap sealant, bonding adhesive, water-block seal, pourable sealer and night sealant.
- E. Fastening Strip: 1" x 1/8" thick aluminum bar pre-drilled or punched for fasteners at 6" o.c. and free of burrs and sharp edges.
- F. Insulation: Closed-cell polyisocyanurate core internally laminated with facers on both sides and having an R-value of at least 5.0 according to ASTM C-518. Atlas Co. AC-Form I or Celotex Hy-Therma are acceptable.

- G. Thermal Barrier: 1/2" thick fiberboard or 1/2" gypsum wallboard type WR, or other approved material in accordance with U.B.C. Standard No. 17-3 and local building official.
- H. "Saddles " or "Crickets": Tapered insulation as specified above, uniformly tapered at 1/4" per foot.
- I. Vapor Retarder: Kraft type paper or aluminum foil type sheet as recommended by the manufacturer, 12" wide continuous; for use below all field lap splices (seams) to prevent adhesive vapor transmission.
- J. Fasteners: Tru-Fast 30 cycle drill point screws or as recommended by the manufacturer, subject to approval by the Owner's Construction Manager and local building official.
- K. Roof Traffic Pads: Semi-rigid type as recommended by the roof membrane manufacturer.
- L. Splash blocks: Pre-cast concrete splash blocks splayed to provide positive drainage away from building face, size as shown on the drawings.

PART 3- EXECUTION

3.0 EXAMINATION

- A. Examine the areas and conditions under which elastic sheet roofing is to be installed and notify the Owner in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.1 INSTALLING INSULATION AND THERMAL BARRIER

- A. Insulation and thermal barrier shall be mechanically fastened to deck using an I-60 pattern to meet manufacturer requirements. The insulation and thermal barrier shall be neatly cut to fit around roof penetrations and projections.
 - 1. Insulation shall be installed in 2 layers (where total insulation thickness exceeds 2" or if tapered system is specified with joints staggered between each layer).
 - 2. Insulation surface joints shall be 1/4" or less in width. Repair joints wider than 1/4" with insulation.
 - 3. In no event shall more insulation be placed on the surface to be roofed than can be covered with roofing membrane prior to the onset of inclement weather, and termination of the day's work. Insulation shall be protected from water at temporary termination during installation by suitable water cut-offs.
- B. Install tapered insulation "saddles" or "crickets" where shown on the drawings to provide proper roof drainage and to avoid ponding water.

3.2 INSTALLING MEMBRANE

- A. Comply with manufacturer's instructions for the installation of membrane, including seaming, self-flashing, reinforcement (if any) and adhering sheets. Cut sheets to the maximum size possible, in order to minimize seams and to accommodate contours of roof deck and proper drainage across the shingled laps of the sheets.
- B. Lap sheets and bond joints by the seaming system recommended by the manufacturer.
- C. Bond sheets uniformly where the membrane and the roof are in contact. Bond the membrane into rain drainage work as indicated. Apply matching adhesive tape where recommended to reinforce the attachment.
- D. Water cut-offs shall be made by extending the membrane beyond the insulation and setting the end of the membrane in 4" of plastic roofing cement. Temporary water cut-offs shall be removed prior to proceeding with the next work period, by cutting off that portion of the membrane that has been in contact with plastic roofing cement, and disposing of it.

3.3 INSTALLING FLASHING

- A. Install flashing at intersections of roof with sloped and vertical surfaces, roof interruptions and penetrations in accordance with manufacturer's currently published drawings, and project drawings, consistent with job conditions.
- B. Extend base flashing up vertical surfaces and onto the horizontal roof surface not less than 3", except as otherwise shown on drawings.
- C. Terminate edges of membrane with continuous aluminum bar fastened 12" o.c. with pre-drilled expansion anchors and screws. Seal edge with lap sealant and water-block seal.

3.4 INSTALLING ROOF TRAFFIC PADS

- A. In areas to receive roof traffic pads, apply sheet membrane roofing manufacturer's recommended adhesive to membrane roof, position pads and embed into adhesive applying uniform weight to entire pad.
 - 1. Space roof traffic pads 1" to 3" apart to permit unrestricted flow of roof water.
 - 2. Width of resulting roof traffic path shall be either 24", standard traffic pad width, or as shown on the drawings, whichever is greatest.

3.5 CURB INSULATION

- A. Apply 3/4" or thicker insulation to mechanical equipment unit curbs and to other curbs where insulation is not provided with the unit.

3.6 SPLASH BLOCKS

- A. Place splash blocks at grade as shown, oriented to provide positive drainage away from building face.

3.7 ADJUSTING AND CLEANING

- A. Inspect work thoroughly and make corrections immediately.

3.8 PROTECTION

- A. The installer shall advise the Contractor and other trades of recommended protection for roofing so that the work will be without damage and deterioration (except for normal weathering) at the time of acceptance.

SECTION 07620 - SHEET METAL FLASHING AND TRIM**PART 1- GENERAL****1.0 SECTION INCLUDES**

- A. Metal flashing and counterflashing.
- B. Metal copings, gravel stops, scuppers, gutters and downspouts.
- C. Exterior Soffits
- D. Roof curbs.
- E. Metal flashing reglets, inserts, miscellaneous sheet metal items, and accessories.
- F. Related sealant work.

1.1 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Sealants for sheet metal work are specified in Section 07900.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Shop Drawings: Typical details of formed configurations.
 - 2. Samples: 2 - 3" x 6" samples of pre-finished sheet metal manufacturer's standard colors.

1.3 QUALITY ASSURANCE

- A. Sheet metal flashing and trim shall conform with the following:
 - 1. Recommended practices contained in "Architectural Sheet Metal Manual", Sheet Metal and Air Conditioning Contractors National Association Inc., (SMACNA) latest edition.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver sheet materials to the job site packaged in manageable bundles, properly labeled or identification. Provide raised platforms and waterproof covers to protect the materials from contamination from dirt and debris.
 - 1. Pre-finished materials masked with factory applied protective film shall be stored protected from the sun's ultraviolet rays until ready for installation.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen and shall remain watertight.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
 - 1. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sf: 60-lbf/sf perimeter uplift force, 90-lbf/sf corner uplift force, and 30-lbf/sf outward force.
 - 2. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sf: 90-lbf/sf perimeter uplift force, 120-lbf/sf corner uplift force, and 45-lbf/sf outward force.
 - 3. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sf: 208-lbf/sf perimeter uplift force, 312-lbf/sf corner uplift force, and 104-lbf/sf outward force.

- C. Thermal movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient surface temperature changes.
- D. Temperature Change (Range): 120 deg F, ambient; 180 deg. F, material surfaces.

1.5 WARRANTY

- A. Special warranty on finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace flashing and trim that shows evidence of deterioration of factory applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to the following;
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- B. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2- PRODUCTS

2.0 MATERIALS

- A. Fascia: Dimensional Metals, Inc. .019" thick smooth aluminum break metal or as specified in drawings.
- B. Exterior Soffit: Dimensional Metals, Inc. .032" thick perforated aluminum v-groove soffit panel VS05, embossed or as specified in drawings
- C. Bay Door Jambs: 0.40" prefinished aluminum
- D. Gutters: Continuous rolled 6" aluminum .032" aluminum or as specified in drawings. Utilize the hidden hanger screw system with neoprene washers.
- E. Downspouts: 3"x4" x .032" thick corrugated complete with matching elbows. Furnish with metal hangers, from same material as downspouts and anchors.
- F. When metal roof is specified, architectural trim, gutters and downspouts shall match roof panels as described in drawings.
- G. Provide color matched fasteners where fasteners are exposed to view.
- H. Provide color matched touch-up paint.

2.1 FABRICATION

- A. Form metal flashing to configurations indicated on the Drawings. Follow standard recommended practices, unless otherwise shown or specified. Fascia on gable ends shall have at least one vertical break near the roof line to provide rigidity of material.
- B. Fabricate and assemble units in the shop. Limit units to 24 feet in length. Where appearance is not a factor, work may be fabricated in 8 to 12 foot lengths.
- C. Fabricate joint cover plates 6' long minimum. Prefabricate corners, minimum 48" long in each direction.
- D. Counter flashing where shown shall be 2-piece type. Receiver shall be minimum 1-1/2" deep, have a hooked end, and a locking slot, factory formed and requiring no malleting and bending to hold cap member. Cap member shall be formed to snap into receiver and provide positive spring action against base flashing.
- E. Fabricate open-face downspouts in regions with severe winters.
- F. No pop rivets shall be permitted in face of trim.

PART 3- EXECUTION

3.0 EXAMINATION

- A. Examine the areas and conditions under which roofing, flashing and sheet metal work is to be installed and notify the Owner in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Coordinate the work with other work for the correct sequencing of items which make up the entire membrane system of weatherproofing and waterproofing, and rain drainage. It is required that the flashing and sheet metal work be permanently watertight, and not deteriorate in excess of manufacturer's published limitations.

3.2 INSTALLATION

- A. Erect members plumb, level and in line securely anchored and properly related to other parts of the Work.
- B. Provide for thermal expansion of exposed sheet metal work. Hold sheet metal joints apart 1/2" and place coverplates over joints embedded in sealant for entire width of coverplate. Fasten sheet metal to wood blocking with screws through neoprene washers 1" minimum penetration. Provide 1 (one) fastener located on the rear side (concealed side) of roof edge and parapet flashing, for each 10' -0" length or less, and 1 (one) fastener located on the rear side of joint cover plates.
- D. Locate joints at roof edge and other work exposed to view with respect to control joints or other architectural features as indicated on the Drawings.
- E. Conceal fasteners and expansion provisions wherever possible.
- F. For counter flashing, place reglets in raked-out mortar joints and wedge with plugs at 12" o.c. and furnish to masonry trade for installation. Snap cap member into reglet in such a manner as to produce spring action pressure against base flashing.
- G. Where required to retain flashings, provide continuous cleat of metal specified. Lock free end of cleat into folded edge of sheet metal.
- H. Install gutter at a 1/2% slope to downspouts. Fasten gutter at adequate spacing (NTE 60") with hidden gutter hangers to secure gutters.
- I. Fasten downspouts securely to wall at bottom, middle and top of downspout with preformed hidden downspout anchors. Utilize a downspout to pipe adapter to tie into drainage system. If no storm drain, utilize elbow and concrete splash block to direct water away from building.
- J. Provide pre-finished liners in open-face downspouts when applicable.

3.3 ADJUSTING AND CLEANING

- A. Remove protective plastic film immediately after installation of pre-finished flashings and miscellaneous fabrications.
- B. Field touch-up marred and abraded surfaces with paint provided.
- C. Replace sections of flashing and trim, which exhibit abrasions on the face of surfaces exposed to view from finished grade.

SECTION 07720 - ROOF ACCESSORIES**PART 1- GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Roof curbs.
 - 2. Equipment supports.
 - 3. Roof supports.
 - 4. Roof access hatches.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
 - 2. Division 07 low-slope roofing Sections for roofing accessories.
 - 3. Division 07 Section "Sheet Metal Flashing and Trim" for metal flashing and counterflashing and miscellaneous sheet metal trim and accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed factory-applied finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.

1.3 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leak-proof, weather-tight, secure, and non-corrosive installation.
 - 1. With Owner's approval, adjust location of roof accessories that would interrupt roof drainage routes.

PART 2- PRODUCTS

2.0 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.1 METAL MATERIALS

- A. Galvanized Steel Sheet: ASTM A 653, G90 coated and mill phosphatized for field painting.
- B. Aluminum Extrusions and Tubes: ASTM B 221, alloy and temper recommended by manufacturer for type of use, mill finished.
- C. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123.
- D. Galvanized Steel Pipe: ASTM A 53.

2.2 MISCELLANEOUS MATERIALS

- A. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, 1 inch thick.
- B. Glass-Fiber Board Insulation: ASTM C 726, 1 inch thick.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.
- D. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities. Do not let mastic come in contact with EPDM roofing material.
- E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non-corrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide non-removable fastener heads to exterior exposed fasteners.
- F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- G. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
- I. Roofing Cement: ASTM D 4586, non-asbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system. Do not let roofing cement come in contact with EPDM roofing material.

2.3 ROOF CURBS

- A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints,

with stepped integral metal cant raised the thickness of roof insulation and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1. Material: Galvanized steel sheet, 0.052 inch thick.
 2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 3. Factory install wood nailers at tops of curbs.
 4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 5. Factory insulate curbs with 1-1/2-inch thick, glass-fiber board insulation.
 6. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
 7. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.
- B. Prefabricated Roof Curbs:
1. CRC-3; Custom Curb, Inc.
 2. PC-2; Pate Company.
 3. RC-2A; Roof Products & Systems Corporation.
 4. TC-3; ThyCurb; Div. of Thybar Corporation.
- C. Pipe and Conduit Penetration Cover Assemblies: Size and quantities of pipes or conduits as shown on Drawings:
1. CRC-3 and PCC; Custom Curb, Inc.
 2. PC-2 and PCC; Pate Company.
 3. EC-2A and N; Roof Products & Systems Corporation.
 4. TC-3 and TP-1; ThyCurb; Div. of Thybar Corporation.
- D. Custom Mechanical Equipment Curbs: For mechanical equipment mounted on structural steel frame:
1. CRC-3 and Isolation Rail; Custom Curb, Inc.
 2. PC-2 and Iso-Base; Pate Company.
 3. RC-2A and VR; Roof Products & Systems Corporation.
 4. TC-3 and Vibra-Curb II; ThyCurb; Div. of Thybar Corporation.
- E. Vibration Isolation Curbs:
1. Custom Isolation Curb; Custom Curb, Inc.
 2. PC-2 and Iso-Base; Pate Company.
 3. RC-2A and VR; Roof Products & Systems Corporation.
 4. TC-3 and Vibra-Curb II; ThyCurb; Div. of Thybar Corporation.

2.4 EQUIPMENT SUPPORTS

- A. Equipment Supports: Provide metal equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Fabricate with welded or sealed mechanical corner joints, with stepped integral metal cant raised the thickness of roof insulation and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
1. Manufacturers:
 - a. CES-2; Custom Curb, Inc.
 - b. ES-2; Pate Company.
 - c. ER-2A; Roof Products & Systems Corporation.
 - d. TEMS-3; ThyCurb; Div. of Thybar Corporation.
 2. Material: Galvanized steel sheet, 0.052 inch thick.
 3. Factory-install continuous wood nailers 5-1/2 inches wide at tops of equipment supports.
 4. Metal Counterflashing: Manufacturer's standard removable counterflashing, fabricated of same metal and finish as equipment support.

5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
7. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.5 ROOF SUPPORTS

- A. Pipe Roof Supports: Adjustable height, extruded-aluminum tube, urethane insulation filled, 2 inches in diameter, with aluminum base plates and manufacturer's recommended hardware for mounting to structure, and extruded-aluminum carrier assemblies, suitable for quantity of pipe runs and sizes, with EPDM end caps. Include manufacturer's standard hardware for mounting to structure or structural roof deck.
 1. Pipe Support Height: As indicated.
 2. Pipe Roller Assembly: Stainless-steel roller assembly sized for supported pipes with extruded aluminum.
 3. Pipe Support Flashing: Insulated sleeve flashings with integral base flange, and EPDM grommetted top seal and base seals.
 - a. Metal: Aluminum sheet, 0.064 inch thick.

2.6 ROOF ACCESS HATCHES

- A. Roof Access Hatch. Provide thermally broken aluminum roof hatch units, with 1" rigid insulation at curbs and door and standard self-lifting mechanism. Provide manufacturer's standard hardware, including hold-open device, hinges, latch and operating handles for inside operation. Construct units to support 40 lbs. per sq. ft. live load.
 1. Curb: 12" high insulated curb.
 2. Size: 36" x 30"
 3. Finish: Mill finish aluminum.
 4. Basis of Design: Provide Type S-50 by Bilco or comparable product by Babcock-Davis, Milcor or approved equal.
- B. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
 1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: 42 inches above finished roof deck
 3. Finish: Mill finish aluminum.
 4. Basis of Design: Model LU-4 by Bilco or comparable product by Babcock-Davis, Milcor or approved equal

PART 3- EXECUTION

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
 2. Verify dimensions of roof openings for roof accessories.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing

- roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
 - C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
 - D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - E. Roof Curb Installation: Set roof curb so top surface of roof curb is level.
 - F. Equipment Support Installation: Set equipment support so top surface of equipment support is level.
 - G. Seal joints with butyl sealant as required by manufacturer of roof accessories.

3.2 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 09 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.3 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

SECTION 07900 - JOINT SEALANTS**PART 1- GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1. SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
 - 1. Exterior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Control and expansion joints in unit masonry.
 - b. Joints between different materials listed above.
 - c. Perimeter joints between materials listed above and frames of doors and windows.
 - d. Control and expansion joints in overhead surfaces.
 - e. Other joints as indicated.
 - 2. Exterior joints in the following horizontal traffic surfaces:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Tile control and expansion joints.
 - c. Joints between different materials listed above.
 - d. Other joints as indicated.
 - 3. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry walls.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - g. Other joints as indicated.
 - 4. Interior joints in the following horizontal traffic surfaces:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.
- B. Related Sections include the following:
 - 1. Division 07 Section "Water-Drainage Exterior Insulation and Finish System (EIFS)" for sealing joints in EIFS construction.
 - 2. Division 08 Section "Glazing" for glazing sealants.
 - 3. Division 09 Section "Tiling" for sealing tile joints.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

- A. Product Data: If requested by Owner; for each joint-sealant product indicated.

- B. Samples: If requested by Owner; for each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Compatibility and Adhesion Test Reports: If requested by Owner; 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 needed for adhesion.
- D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than four pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.5 PROJECT 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. Concrete and masonry must be cured a minimum of 28 days and be clean, dry and frost free.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric 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's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural 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

2.0 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Single-Component Neutral-Curing Silicone Sealant:
 - 1. Products:
 - a. Dow Corning Corporation; 791.
 - b. Pecora Corporation; 895.
 - c. Polymeric Systems Inc.; PSI-641.
 - d. Tremco; Spectrem 3.
 - 2. Type and Grade: S (single component) and NS (non-sag).
 - 3. Class: 50.
 - 4. Use Related to Exposure: NT (non-traffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - 6. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
 - 7. Color: To match adjacent surfaces as selected by Architect.
- C. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant:
 - 1. Products:
 - a. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Silicones; Sanitary SCS1700.
 - c. Tremco; Tremsil 200 White.
 - 2. Type and Grade: S (single component) and NS (non-sag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (non-traffic).

5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
- D. Multi-Component Non-Sag Urethane Sealant:
 1. Products:
 - a. ITW Polymers Sealants.; SM-7120PU
 - b. Sika Corporation, Inc.; Sika Flex 1A NS polyurethane sealant.
 - c. Tremco; Vulkem 227.
 2. Type and Grade: M (multi-component) and NS (non-sag).
 3. Class: 25.
 4. Uses Related to Exposure: T (traffic) and NT (non-traffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
- E. Multi-Component Pourable Urethane Sealant:
 1. Products:
 - a. Pecora Corporation; Dynatrol II-SG.
 - b. Sika Corporation, Inc.; Sikaflex - 2c SL.
 2. Type and Grade: M (multi-component) and P (pourable).
 3. Class: 25.
 4. Uses Related to Exposure: T (traffic) and NT (non-traffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

2.3 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.
 1. Products:
 - a. Bostik Findley; Chem-Calk 600.
 - b. Pecora Corporation; AC-20+.
 - c. Tremco; Tremflex 834.

2.4 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) 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. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 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: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3- EXECUTION

3.0 EXAMINATION

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

3.1 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, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean non-porous 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.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates, where indicated or recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. 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 Non-Sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Apply Sika Flex 1A NS polyurethane sealant. Color: Black at base edge of pit steel and floor.. Apply on a 45 degree angle to prevent ponding.

3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform five tests for the first 500 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab in Appendix X1 in ASTM C 1193, as appropriate for type of joint-sealant application indicated.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
 - 4. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free of voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.

5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 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.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior horizontal non-traffic and traffic isolation and contraction joints in cast-in-place concrete slabs.
1. Joint Sealant: Multi-component pourable urethane sealant.
 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.
1. Joint Sealant: Multi-component non-sag urethane sealant.
 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- C. Joint-Sealant Application: Exterior vertical joints between different materials listed above.
1. Joint Sealant: Multi-component non-sag urethane sealant.
 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- D. Joint-Sealant Application: Exterior perimeter joints between exterior unit masonry or exterior insulation and finish systems and frames of doors or windows.
1. Joint Sealant: Multi-component non-sag urethane sealant.
 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- E. Joint-Sealant Application: Exterior control and expansion joints in ceilings and other overhead surfaces.
1. Joint Sealant: Multi-component non-sag urethane sealant.
 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- F. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
1. Joint Sealant: Single-component neutral-curing silicone sealant.
 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- G. Joint-Sealant Application: Interior perimeter joints of exterior openings.
1. Joint Sealant: Latex sealant.
 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.

- H. Joint-Sealant Application: Interior ceramic tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.
 - 1. Joint Sealant: Multi-component non-sag urethane sealant.
 - 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- I. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 1. Joint Sealant: Single-component mildew-resistant acid-curing silicone sealant.
 - 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- J. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry and walls and partitions.
 - 1. Joint Sealant: Latex sealant.
 - 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.
- K. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - 1. Joint Sealant: Latex sealant.
 - 2. Joint-Sealant Color: As selected by Owner from manufacturer's full range.

SECTION 08110 – HOLLOW METAL DOORS AND FRAMES**PART 1- GENERAL****1.0 RELATED DOCUMENTS**

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

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.
- B. Related Sections:
 - 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 2. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
 - 3. Division 08 Section "Glazing" for glass lites in hollow metal doors.
 - 4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 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 anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of conduit and preparations for power, signal, and control systems.
- C. Other Action Submittals:
 - 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, 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 finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages 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.

PART 2- PRODUCTS**2.0 MANUFACTURERS**

- A. Manufacturers Supplier: Subject to compliance with requirements, provide hollow metal doors and frames as scheduled on Drawings by the following:
 - 1. Ceco, Curries or Trussbilt.

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with minimum A40 metallic coating.
- D. Frame Anchors: ASTM A 591, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.
- G. Glazing: Comply with requirements in Division 08 Section "Glazing."
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.2 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: Flush
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 12.3 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch thick, end closures or channels of same material as face sheets.
 - 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: 16 Gauge. Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).
- C. Interior Doors: 18 Gauge. Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 1 and Physical Performance Level C (Standard Duty), Model 2 (Seamless), 1-3/4 inch width.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.3 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: 14 Gauge, fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded, unless otherwise indicated.
 - 3. Frames for Exterior Steel Doors: 0.053-inch thick steel sheet.
- C. Interior Frames: 16 Gauge, fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Frames for Interior Steel Doors: 0.053-inch thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Post-installed Expansion Type for In-Place Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

2.5 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

2.6 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.7 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Four anchors per jamb.
 - c. Compression Type: Not less than two anchors in each jamb.
 - d. Post installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 - 6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 3. Provide loose stops and moldings on inside of hollow metal work.
 4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.8 STEEL FINISHES

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

PART 3- EXECUTION

3.0 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 embedded and built-in anchors to verify actual locations before frame installation.

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.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. 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, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Install door silencers in frames before grouting.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - e. Field apply bituminous coating to backs of frames that are filled with grout containing anti-freezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 5. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 6. In-Place Gypsum Board Partitions: Secure frames in place with post-installed expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - c. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
 - 1. Secure stops 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.

3.3 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. 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.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

SECTION 08305 - ACCESS DOORS AND FRAMES**PART 1- GENERAL****1.0 RELATED DOCUMENTS**

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

1.1 SUMMARY

- A. This Section includes wall and ceiling access doors and frames.
 - 1. Access doors and frames are to be used where required to access concealed items for maintenance and systems operation where indicated on Drawings or as required due to system installation.
 - a. Provide fire-rated wall and ceiling access doors and frames to correlate with fire rated construction if applicable.

1.2 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- B. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access doors and frames through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for vertical access doors and frames.
 - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.
- C. Size Variations: Obtain Owner's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.4 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2- PRODUCTS**2.0 MANUFACTURERS**

- A. Manufacturers:
 - 1. Nystrom Building Products
 - 2. Owner approved equal.

2.1 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Steel Sheet: Uncoated or electrolytic zinc-coated, ASTM A 591 with cold-rolled steel sheet substrate complying with ASTM A 1008, Commercial Steel (CS), exposed.
- C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
- D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 PAINT

- A. Shop Primer for Ferrous Metal: Fast curing, lead and chromate free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
 - 1. Apply shop primer immediately after cleaning and pretreating.

2.3 ACCESS DOORS AND FRAMES

- A. Access Door and Frame, Type II: Flush, uninsulated, fire-rated access doors and trimless frames, fabricated from stainless steel sheet.
 - 1. Nystrom Model XTN18x18CS
 - a.) Includes drip cap, gasket, masonry anchors, and mortise preparation.
 - 2. Lock cylinder: Key operated cylinder lock prepared for 1-1/8" mortise cylinder.

2.4 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 attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 2. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish two keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

PART 3- EXECUTION

3.0 INSTALLATION

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

- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.1 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

SECTION 08360 - OVERHEAD DOORS**PART 1- GENERAL****1.0 SUMMARY**

- A. Includes the furnishing of all materials, labor, tools, and equipment required for installation of the overhead sectional bay doors, for the project as herein specified and indicated on the drawings.

1.1 RELATED WORK

- A. Section 04200 - Masonry
- B. Section 06100 - Carpentry
- C. Section 08800 - Glass and Glazing
- D. Division 26 Sections for electrical connections including conduit and wiring for door operators.

1.2 PERFORMANCE REQUIREMENTS

- A. Wind Loading: Sectional overhead doors shall withstand a minimum wind loading pressure as noted in the Structural Drawings.
- B. Deflection: Maximum deflection of door in horizontal position shall be 1/120 of door width.

1.3 SUBMITTALS

- A. Shop Drawings: Show application to project.
- B. Product Data: Catalog sheets, specifications, and installation instructions for overhead door assemblies, finishes, and operators.
 - 1. Include complete data covering motors and controls for electric operation.
- C. Quality Control Submittals:
 - 1. Certificates: Furnish door manufacturer's certifications that the spring life of counterbalance mechanism is 100,000 cycles or more.
- D. Contract Closeout Submittals:
 - 1. Operation and maintenance data.
 - 2. Replacement parts list.

1.4 WARRANTY

- A. As set out under section 01011 – General Conditions, warranty shall be for a period of 12 months from date of substantial completion of the project.

PART 2- PRODUCTS**A. ACCEPTABLE MANUFACTURER'S**

- 1. Overhead doors: Overhead Door Company Inc. (NATIONAL ACCOUNT – See drawings for info)
Alternate: Clopay
- r 2. Door Openers: Overhead Door Company Inc.
Alternate: Clopay

2.1 MATERIALS FOR OVERHEAD DOORS

- A. Track for doors shall be 2" Standard Lift or High Lift
- B. Doors shall be manufactured in strict accordance with the requirements of Underwriters Laboratories listed procedures.
- C. Door sizes shall be as shown on drawings.
- D. Clear anodized aluminum unless specified otherwise in drawings.
- E. Glazing: Refer to drawings and COMChecks for requirements.

- F. Provide all necessary tracks, guides, mountings, fasteners and accessories required for complete installation.
- G. MATERIALS FOR DOOR OPENERS
 - a. Overhead Door OM-RSX-SECT-Trolley
 - b. Clopay Door Opener – Contact Manufacturer's Representative

2.3 ALUMINUM DOOR SECTION

- A. Door:
 - 1. Sections: Door sections shall be fabricated from extruded aluminum shapes of 6063-T6 alloy, with wall thickness not less than 0.07 inch for a door section 1-3/4 inches thick.
 - 2. Stiles and rails shall be joined together with concealed 1/4 inch minimum diameter aluminum or non-magnetic stainless steel through-bolts full height of section.
 - 3. Meeting rails shall be formed to provide a rabbeted weather seal joint. Joints shall be welded in unexposed locations.
 - 4. Finish: Cleananodized aluminum unless specified differently in drawings.
 - 5. Bottom Rail: Reinforced full-width extruded angle, retaining U-shaped ribbed vinyl astragal.

2.4 ACCESSORIES

- A. Weatherstripping:
 - 1. Sill: Compressible and replaceable; neoprene or vinyl astragal, attached to bottom of door.
 - 2. Jamb: Neoprene or vinyl seal, full height of door.
 - 3. Head: Continuous neoprene or vinyl seal, attached to top of door.
 - 4. Door Section Joints: Compressible gasket in joints of meeting edges.
 - 5. Securely attach sill, jamb and head weatherstripping with metal fasteners or approved retainers; adhesive application will not be acceptable.
- B. Vision Panels: Refer to drawings and COMChecks for requirements.
- C. Metal Doors: Double-strength, "B" grade, clear sheet glass, set in rubber or neoprene channel glazing strips, with either removable interior stop of same material as door section framing or integral rubber for neoprene gasket stops.
 - 2. Alternate price to install "Safety Glass".

2.5 TRACKS, SUPPORTS, AND BUMPERS

- A. Tracks and Reinforcement: Galvanized steel tracks and reinforcement. Reinforce vertical tracks with heavy duty mounting brackets 16 inches oc or continuous steel angles welded or through bolted to track. Incline vertical tracks or otherwise design to ensure weathertight closure at jambs when door unit is closed. Reinforce horizontal tracks with continuous steel angles welded to track. Track system shall allow for normal door movement caused by temperature changes.
- B. Track Supports: Galvanized steel shapes, except as otherwise indicated.
- C. Door Bumpers: Compression spring or leaf spring bumper located at the end of each horizontal track, designed to cushion and stop door at end of opening operation.

2.6 HARDWARE

- A. Hinges and Roller Brackets: Minimum 13 gage steel hinges at each end stile and at each intermediate stile. Fabricate end stile hinges for mounting of rollers. Attach hinges to stiles and rails with thru bolts and lock nuts or lock washers and nuts, except self-tapping fasteners may be used on steel doors. Doors 14'-0" and over in width shall have double end hinges.
- B. Rollers: Heavy duty rollers with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Where double hinges are required extend roller shaft through both hinges. Roller tires shall suit size of track and be the following type:
 - 1. Steel tires,
- C. Finish: Galvanized, unless otherwise indicated.

1. Fasteners: Galvanized, cadmium plated or stainless steel, and compatible with door type.

2.7 COUNTERBALANCING MECHANISM

- A. Type: Torsion spring counterbalance mechanism consisting of helical wound oil-tempered steel torsion springs having a minimum spring life of 100,000 cycles, mounted on a solid steel keyed shaft, and connected to door with aircraft quality grade galvanized steel lift cable having a minimum safety factor of 7 to 1. Required operation force shall not exceed the following:
- B. Drums and Brackets: Cast aluminum or grey iron casting cable drums, grooved to receive and hold proper diameter cable. Counterbalance mechanism shall be mounted with adjustable ball-bearing brackets at each end of shaft and one additional mid-point bracket for shafts up to 16 feet long and 2 additional brackets at 1/3 points to support shafts over 16 feet long, unless closer spacing recommended by door manufacturer.

2.8 ELECTRIC OPERATION

- A. UL listed electric operator assembly, complete with operator/motor unit, factory pre-wired motor controller, limit devices, and remote control stations. Motor shall be removable without disturbing the limit switch adjustment and without affecting the emergency release mechanism. Approved Manufacturer- Overhead Door model OM-RSX-SECT-Trolley or OM-RSX-SECT-Jackshaft or alternate Clopay Door Opener (Contact Manufacturer's representative for model information)..
- B. Trolley/Drawbar Operator: V-belt or gear primary drive to suit door load and job conditions, chain and sprocket secondary drive, adjustable safety clutch, solenoid operated brake, emergency release mechanism with an auxiliary steel chain hoist which can be engaged/disengaged from floor level for mechanical operation, provide an interlock device to prevent motor from operating when release mechanism is activated. Chain to remain motionless during electric operation.
 1. Reinforce door section for operation attachment.
- C. Jackshaft/Hoist Operator: Side-mounted or center-mounted with V-belt, chain or gearhead primary drive to suit door load and job conditions, roller chain secondary drive, adjustable safety clutch, solenoid operated brake, emergency release mechanism with an auxiliary steel chain hoist which can be engaged/disengaged from floor level for mechanical operation, provide an interlock device to prevent motor from operating when release mechanism is activated. Chain to remain motionless during electric operation.
- D. Motor: Horsepower rating as required to open and close door at a speed not less than 3/4 foot or more than 1-1/4 feet per second without overload under any condition of operation.
 1. Motors shall comply with NEMA standards.
 2. Motors shall be designed to operate on single phase, 60 Hertz, 120 volt circuit (NEMA standard motor voltage 115V).
 3. Mount motor separate from reduction mechanism.
 4. Bearings: Equip motors 1/2 HP and larger with ball bearings.
 5. Housing: Drip-proof.
- E. Reversing Magnetic Motor Controller:
 1. Manufacturer: Allen-Bradley Co.; Cutler-Hammer, Inc.; General Electric Co.; Square D Co.; Westinghouse Electric Corp.
 2. Enclosure: NEMA 1.
 3. Control Power: Control power transformer (maximum control voltage 120 volts) mounted within motor controller enclosure.
- H. Push Button Control Stations (Interior): Momentary Pressure Switch, 3 push buttons labeled OPEN, CLOSE, STOP.
 1. Enclosure: NEMA 1, surface mounted unless otherwise indicated.
 2. Manufacturer: Allen-Bradley Bulletin 800S; Cutler-Hammer, Inc. Bulletin 10250; General Electric Co. CR-2943; Westinghouse Electric Corp. Type HD.
- I. Electrical Eye Safety Sensors – Coordinate quantities and model # information with drawings and NATIONAL ACCOUNT MANAGER.

PART 3- EXECUTION**3.0 EXAMINATION**

- A. Verification of Conditions: Examine door openings for defects that will adversely affect the execution and quality of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.1 INSTALLATION

- A. Install the Work of this Section in accordance with manufacturer's printed instructions, except as shown or specified otherwise.
 - 1. Field connections and fastening shall be as recommended by the door manufacturer for the conditions, unless otherwise indicated.
- B. Secure and support tracks as required to prevent sag, sway, and detrimental vibration during opening and closing of door.
 - 2. Fasten vertical track assembly to framing with continuous steel angles 24 inches oc or with mounting brackets 16 inches oc.
 - 3. Support horizontal (ceiling) track assembly with laterally-braced hanger at end of track, secured to overhead structural members. For doors 10 feet high and over, install an additional laterally-braced hanger at the center of horizontal tracks. Also secure horizontal track reinforcement at wall.
- C. Install bracing and supports as necessary to rigidly secure door operating equipment and appurtenances.

3.2 ADJUSTING

- A. Adjust and lubricate doors and operating equipment to operate smoothly. Adjust door fit and weatherstripping to make a watertight fit for the door perimeter.

3.3 FIELD QUALITY CONTROL

- A. Test all doors for proper operation before turning units over to the Director's Representative after testing.

3.4 CLEANING

- A. Clean doors, and clean work area surfaces that have been soiled performing the Work.

SECTION 08410 – ALUMINUM FRAMED ENTRANCES AND STOREFRONTS**PART 1- GENERAL****1.0 SECTION INCLUDES**

- A. Glazed aluminum doors for manual operation.
- B. Glazed aluminum storefront.
- C. Aluminum flashing.

1.1 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Sealants as specified in Section 07900.
- B. Glass and glazing materials as specified in Section 08800.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Manufacturer's Literature: Materials description and installation instructions for each system.
 - 2. Shop Drawings: Indicate sections of typical members, dimensioned plans and elevations, anchors and fasteners and their spacing, and full details of accessories required.
 - a. Show glass thickness and glazing details.
 - b. Show dimensions, installation and erection details, including connections, fasteners and welds.
 - c. Provide scaled drawings as follows:
 - 1) Plans and wall elevations at 1/2" = 1' -0".
 - 2) Typical composite members at full scale.
 - 3. Samples: If requested by Owner,
 - a. Two 8" lengths of aluminum extrusion in the finish specified.

1.3 QUALITY ASSURANCE

- A. Comply with the provisions of the following codes specifications and standards except where more stringent requirements are shown on the Drawings and specified herein.
 - 1. Aluminum Association (AA).
 - 2. American Architectural Manufacturers Association (AMA)
 - 3. National Association of Architectural Metal Manufacturers (NAMM).
 - 4. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver entrances and storefront to the Project site clearly marked for proper identification.
- B. Store in accordance with manufacturer's instructions, above ground, and protected from weather, construction activities, and other causes of damage.
- C. Materials shall be handled at the Project site to prevent damage. All damaged and otherwise unsuitable material when so determined shall be immediately removed from the Project site.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: 2 years from date of Substantial Completion.

PART 2- PRODUCTS

2.0 ACCEPTABLE MANUFACTURERS

- A. Kawneer North America; an Alcoa Company

2.1 SYSTEMS

- A. For reference purposes only, Kawneer components are specified herein.
- B. Storefront
 - 1. "Trifab" 451-T, nominal 4 1/2" x 2", mullion system.
- C. Doors: "350" medium stile.

2.2 MATERIALS

- A. Aluminum Materials:
 - 1. Alloy: 6063 T5
 - 2. Thickness: As necessary to comply with structural and wind loading requirements, but not less than the following:
 - a. Principal Extrusions: 0.125".
 - b. Principal Formed Sheet Members: 0.125".
 - c. Extruded Glazing Stops and Trim: 0.062".
 - d. Formed Glazing Stops and Trim: 0.050".
 - f. Sheet 0.050".
- B. Aluminum, non-magnetic stainless steel, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum components.
 - 1. Do not use exposed fasteners except where unavoidable for application of hardware. Match finish of adjoining metal.
 - 2. Provide Phillips flat-head machine screws for exposed fasteners.
- C. Concealed Flashing: Dead-soft stainless steel 26-gauge minimum, type selected by manufacturer for compatibility.
- D. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible; otherwise, non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A123
- E. Concrete/Masonry Inserts: Cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A123.
- F. Compression Weather-stripping: Manufacturer's standard replaceable stripping of either molded neoprene gaskets complying with ASTM D2000 or molded PVC gaskets complying with ASTM D2287.
- G. Sliding Weather-stripping or sweeps: Manufacturer's standard replaceable stripping of wool, polypropylene, or nylon woven pile, with nylon fabric and aluminum strip backing.

- H. Aluminum Flashings: Smooth finish aluminum 0.062" (minimum thickness), finish to match storefront system.
- I. Refer to drawings for hardware schedule information.

2.3 FABRICATION

- A. General:
 - 1. Coordination of Fabrication: Wherever possible, check the actual frame openings and door openings in the construction work by accurate field measurement before fabrication, and show recorded measurements on final Shop Drawings. However, coordinate fabrication schedule with construction progress as directed by Contractor and avoid delays of the work. Coordinate installation tolerances to ensure proper fit of door and frame units.
 - 2. Sizes and Profiles: Required sizes for door and frame units, including profile requirements, are shown on drawings and on the door and hardware schedule. Variable dimensions are indicated, together with maximum and minimum dimensions required to achieve design requirements and coordination with other work.
 - 3. Prefabrication: To greatest extent possible, complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site. Disassemble components only as necessary for shipment and installation.
 - 4. Sequence: Complete cutting, fitting, forming, drilling, and grinding of metal work prior to cleaning, finishing, surface treatment, and application of finishes. Remove arises from cut edges and ease edges and corners to radius of approximately 1/64".
 - 5. Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds smooth and restore mechanical finish.
 - 6. Reinforcing: Install reinforcing as necessary for performance requirement, separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.
 - 7. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.
 - 8. Fasteners: Conceal fasteners wherever possible.
 - 9. All vertical members shall be continuous sections with no splices through its entire length.
- B. Stile-and-Rail Type Aluminum Doors:
 - 1. Frame: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts, on fabricate with structurally welded joints, at manufacturer's option.
 - 2. Glazing: Fabricate doors to facilitate replacement of glass and panels, without disassembly of door stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal.
- C. Non-Thermal Construction: Fabricate tubular and channel frame assemblies, as shown, with either welded or mechanical joints in accordance with manufacturer's standards, reinforced as necessary to support required loads.
- D. Finishes:
 - 1. Clear anodized finish unless specified otherwise in drawings, to comply with AAMA 611, AA-M12C22A41, Class I coating .018 mm or thicker.

2.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:

- a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
4. Notice of Acceptance: Provide products, in hurricane regions only, having a current Dade County Notice of Acceptance (NOA).
- a. Submit structural design and engineering calculations for windows, doors and anchors prepared by, signed, and sealed by a licensed professional engineer within the same state as the designated construction location
 - b. All storefront window anchorage shall be designed to comply with the local wind load requirements of the designated construction location.
- B. Structural Loads: Provide aluminum-framed storefront system designed to perform under a wind pressure of 30lbf/sq.ft. acting inward and outward on adjoining window surfaces, but not for simultaneous occurrence. Anchors used to secure to the building shall be designed and engineered to comply with wind load requirements to comply with applicable building code requirements.
- C. Deflection of Framing Members:
- 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch and clearance between members and operable units directly below them to less than 1/16 inch.
- D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
- 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Windborne-Debris-Impact-Resistance Performance: Provide aluminum-framed systems that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 or AAMA 506.
- 1. Large-Missile Impact: For aluminum-framed systems located within 30 feet of grade.
 - 2. Small-Missile Impact: For aluminum-framed systems located more than 30 feet above grade.
- F. Structural Support Movement: Provide aluminum-framed systems that accommodate structural movements including, but not limited to, sway and deflection.
- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
- H. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
- I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface

temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 35 when tested according to AAMA 1503.
- K. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.
- L. Dimensional Tolerances: Provide aluminum-framed systems that accommodate dimensional tolerances of building frame and other adjacent construction.

PART 3- EXECUTION

3.0 EXAMINATION

- A. Examine the surrounding structure and the conditions under which the work is to be erected, and notify the Contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of aluminum framing systems.
- B. Set units plumb, level, and true to line, without warp and rack of framing members doors, and panels. Care should be taken as not to force units into position that would result in inherent stresses. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action
- C. Set sill members and other members in a bed of grout as shown.
- D. Comply with manufacturer's recommendations and Section 08800 for glass and glazing work.
- E. Cooperate and coordinate with Electrical Subcontractor and Owner's Security Alarm Contractor in installing low voltage wiring and reed switches in door frame heads and master keying system for security requirements if required.
- F. Bolt through frames and doors in order to attach closures and apply surface-mounted hardware items complying with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
- G. Install push/pull bars at a height of 3'-8" above finish floor.
- H. Vertical mullions to be terminated short of bottom side of truss so as to allow for live load deflection of roof system.

3.2 ADJUSTING AND CLEANING

- A. Adjust operating hardware to function properly, without binding, and to provide tight fit at contact points and weather-stripping.
- B. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.
- C. Clean completed system, inside and out, promptly after erection and installation of glass and sealants. Remove excess glazing and sealant compounds, dirt, and other substances from aluminum surfaces.

- D. Advise Contractor of protective treatment and other precautions required through the remainder of the construction period, to ensure that doors and frames will be without damage and deterioration (other than normal weathering) at the time of acceptance.

SECTION 08710 - DOOR HARDWARE**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware for the following:
 - a. Swinging doors.
 - b. Other doors to the extent indicated.
 - 2. Cylinders for doors specified in other Sections.
- B. Related Sections include the following:
 - 1. Division 08 Section "Hollow Metal Doors and Frames."
- C. Products furnished, but not installed, under this Section include the following.
Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
 - 1. Cylinders for locks specified in other Sections.

1.2 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.
- C. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
- B. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

1.5 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails 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 operators and door hardware.
 - c. Deterioration of metals, metal finish, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, except as follows:
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 PRODUCTS

2.0 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and as indicated in the Door Hardware Schedule in the drawings
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware section of the drawings. Products are identified by using door hardware designations, as follows:

2.1 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
 - 1. Two Hinges: For doors with heights up to 60 inches.
 - 2. Three Hinges: For doors with heights 61 to 90 inches.
- B. Hinge Weight: Unless otherwise indicated, provide the following:
 - 1. Entrance Doors: Heavy-weight hinges.
 - 2. Doors with Closers: Antifriction-bearing hinges.
 - 3. Interior Doors: Standard-weight hinges.
- C. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Exterior Hinges: Satin Nickel, with stainless-steel pin body and Brushed Satin protruding heads.
 - 2. Interior Hinges: Satin Nickel, with stainless-steel pin body and Satin Nickel protruding heads.
- D. Hinge Options: Where indicated in door hardware sets or on Drawings:
 - 1. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for out-swinging exterior doors.
 - 2. Corners: Square.
- E. Fasteners: Comply with the following:
 - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - 2. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.2 HINGES

- A. Butts and Hinges: BHMA A156.1. Listed under Category A in BHMA's "Certified Product Directory."
 - 1. Manufacturers:
 - a. Bommer Industries, Inc
 - b. Hager
 - c. Stanley Commercial Hardware; Div. of The Stanley Works.

2.3 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with [the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and ANSI 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.
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbs to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
 - 1. Levers: Cast.
 - 2. Escutcheons (Roses): Cast.
 - 3. Lockset Designs: Provide design indicated on Drawings or, if sets are provided by another manufacturer, provide designs that match those designated.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
- E. Backset: 2-3/4 inches, unless otherwise indicated.
- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:
 - a. Strikes for Mortise Locks and Latches: BHMA A156.13.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
 - 1. Mortise Locks: BHMA A156.13.
- B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13.
 - 1. Manufacturers:
 - a. Best

2.5 DOOR BOLTS

- A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Fire-Rated Surface Bolts: Minimum 1-inch throw; listed and labeled for fire-rated doors.
 - 2. Mortise Flush Bolts: Minimum 3/4-inch throw.
- B. Dustproof Strikes: BHMA A156.16, Grade 1.
- C. Surface Bolts: BHMA A156.16.
 - 1. Flush Bolt Heads: Minimum of 1/2-inch diameter rods of brass, bronze, or stainless steel with minimum 12-inch long rod for doors up to 84 inches in height. Provide longer rods as necessary for doors exceeding 84 inches.
 - 2. Manufacturers:
 - a. Hager Companies

- b. Stanley Commercial Hardware; Div. of The Stanley Works
 - c. Trimco
- D. Manual Flush Bolts: BHMA A156.16, Grade 1 unless Grade 2 is indicated; designed for mortising into door edge.
 - 1. Manufacturers:
 - a. Hager Companies
 - b. Stanley Commercial Hardware; Div. of The Stanley Works
 - c. Trimco

2.6 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1 unless Grade 2 is indicated. Listed under Category G in BHMA's "Certified Product Directory."
- B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and ANSI 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.
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- F. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.
 - 1. Match design for locksets and latchsets, unless otherwise indicated.
- G. Through Bolts: For exit devices and trim on metal doors and fire-rated wood doors.
- I. Manufacturers:
 - 1. Adams Rite Manufacturing Co
 - 2. Detex Corporation
 - 3. DORMA Architectural Hardware; Member of The DORMA Group North America
 - 4. Von Duprin; an Ingersoll-Rand Company

2.7 LOCK CYLINDERS

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1 unless Grade 2 is indicated.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 - 1. Number of Pins: Seven.
 - 2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 - 3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - a. High-Security Grade: BHMA A156.5, Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- D. Construction Keying: Comply with the following:
 - 1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

- a. Replace construction cores with permanent cores as directed by Owner.
 - b. Furnish permanent cores to Owner for installation.
- E. Manufacturer: Best.

2.8 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:
 - 1. Master Key System: Cylinders are operated by a change key and a master key.
 - 2. 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. All exterior doors shall be master keyed.
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Furnish one extra blank for each lock.

2.9 OPERATING TRIM

- A. Standard: BHMA A156.6 and as illustrated on Drawings.
- B. Manufacturers:
 - 1. Hager Companies
 - 2. IVES Hardware; an Ingersoll-Rand Company
 - 3. Rockwood Manufacturing Company
 - 4. Trimco

2.10 CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and ANSI A117.1.
 - 1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbs to set door in motion and not more than 15 lbs to open door to minimum required width.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations 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.
- D. Surface Closers: BHMA A156.4, Grade 1 unless Grade 2 is indicated. Listed under Category C in BHMA's "Certified Product Directory." Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.
 - 1. Manufacturers:
 - a. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
 - b. LCN Closers; an Ingersoll-Rand Company
 - c. Norton Door Controls; an ASSA ABLOY Group company

2.11 PROTECTIVE TRIM UNITS

- A. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.
- B. Fasteners: Manufacturer's standard machine or self-tapping screws.
- C. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from material indicated in door hardware sets.
 - 1. Manufacturers:
 - a. Hager Companies
 - b. IVES Hardware; an Ingersoll-Rand Company
 - c. Rockwood Manufacturing Company
 - d. Trimco

2.12 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1 unless Grade 2 is indicated.
 - 1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
- B. Combination Floor and Wall Stops and Holders: BHMA A156.8, Grade 1 unless Grade 2 is indicated.
- C. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.
- D. Manufacturers:
 - 1. Hager Companies
 - 2. IVES Hardware; an Ingersoll-Rand Company
 - 3. Rockwood Manufacturing Company
 - 4. Stanley Commercial Hardware; Div. of The Stanley Works
 - 5. Trimco

2.13 DOOR GASKETING

- A. Standard: BHMA A156.22, Listed under Category J in BHMA's "Certified Product Directory."
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide non-corrosive fasteners for exterior applications and elsewhere as indicated.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 2. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- C. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- D. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Gasketing Materials: ASTM D 2000 and AAMA 701/702.
- G. Manufacturers:
 - 1. Hager Companies
 - 2. National Guard Products
 - 3. Pemko Manufacturing Co
 - 4. Reese Enterprises
 - 5. Zero International

2.14 THRESHOLDS

- A. Standard: BHMA A156.21. Listed under Category J in BHMA's "Certified Product Directory."
- B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and ANSI A117.1.
 - 1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.
- D. Manufacturers:
 - 1. Hager Companies (HAG).National Guard Products
 - 2. Pemko Manufacturing Co
 - 3. Reese Enterprises
 - 4. Zero International

2.15 FABRICATION

- A. Base Metals: Produce door hardware units of base metal, 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 BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- B. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except 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. Steel Machine Screws: For the following fire-rated applications:
 - a. Mortise hinges to doors.
 - b. Strike plates to frames.
 - c. Closers to doors and frames.
 - 3. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:
 - a. Surface hinges to doors.
 - b. Closers to doors and frames.
 - c. Surface-mounted exit devices.
 - 4. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

2.16 FINISHES

- A. Standard: BHMA A156.18, Satin Nickel or as indicated in door hardware schedule in drawings
- 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

3.0 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

3.2 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- 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 specified in Division 09 Sections. 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 according to industry standards.
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING

- A. 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: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3.4 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.

SECTION 08800 – GLASS AND GLAZING**PART 1 GENERAL****1.0 SECTION INCLUDES**

- A. Glass glazed into frames (except factory glazed windows).
- B. Setting materials and cleaners.

1.1 RELATED SECTIONS

- A. Section 10820 - Toilet Accessories: For framed mirrors.

1.2 QUALITY ASSURANCE

- A. Unless otherwise shown, or governed by other reference standards specified, conform with details and procedures of the "Glazing Manual, 1986 Edition" (Flat Glass Marketing Association).
- B. American National Standard Institute (ANSI) Z97.1.
 - 1. Each piece of safety glass shall exhibit appropriate label.
- C. Consumer Product Safety Commission (CPSC), "Safety Standards for Architectural Glazing Materials".

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver glazing materials to Project site in manufacturer's unopened containers, fully identified with trade name, color, size, hardness, type, class, and grade. Store each item in accordance with manufacturer's instructions. Damaged and otherwise unsuitable material, when so determined, shall be immediately removed from the Project site.

1.4 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 40 degrees F. during glazing unless the manufacturer of the glazing materials specifically agrees to installation of specified materials at lower temperatures. If job progress and other conditions require glazing work when temperatures are below 40 degrees F. (or below the minimum temperature recommended by the manufacturer), consult the manufacturer and establish the minimum provisions required to ensure satisfactory work. Record in writing to the manufacturer, with copy to the Owner's Construction Manager, the conditions under which such glazing work proceeds, and the provisions made to ensure satisfactory work.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Exterior Wind and Impact Loading: Provide exterior glass to withstand wind loading pressures in accordance with the following
- C. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 60 seconds or less.
 - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - 1) For insulating glass.
 - d. In areas required to meet hurricane exterior wind and impact loading requirements, provide exterior glass to withstand wind loading pressures in accordance with the following:
 - 1) Provide products meeting the design pressure requirements indicated in the wind tunnel study, RWDI 06-1081.
 - 2) Provide products having a current Dade County (Florida) Notice of Acceptance (NOA).
- D. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 2. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.9 WARRANTY

- A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: 10-years from date of Substantial Completion.

PART 2 PRODUCTS

2.0 ACCEPTABLE MANUFACTURERS

- A. Primary Glass Products and Insulated Units:
 1. Cardinal IG
 2. Falconer Glass Industries, Inc.
 3. Ford Motor Co., Glass Div.
 4. Guardian Industries, Corp.

5. Libbey-Owens-Ford Co.
 6. PPG Industries, Inc. Glass Group
 7. Viracon, Inc.
 8. Tempglass, Inc.
- B. Other Materials - As specified in Article 2.02.

2.1 MATERIALS

- A. Clear Float Glass: ASTM C1036 Type 1, Class 1 Quality q3, 1/4" thick clear.
- B. Colored Plate Glass: ASTM C1036, 1/4" thick, graylite #14.
- C. Tempered Float Glass: Float glass which has been heat strengthened (fully tempered) to achieve strength 4 to 5 times stronger than regular annealed glass, complying with ASTM C1048 and ANSI-Z97.1. Glass shall be tempered horizontally. (Tong marks at top only will be permitted).
- D. Insulating Glass: 1" insulating glass complying with ASTM E774 as tested and approved in accordance with SIGMA, Sealed Insulating Glass Manufacturers Association requirements. Provide following where shown:
 1. Type A: 1/4" clear glass outboard, 1/2" air space and 1/4" clear glass inboard.
 - a. Temper both panes where shown on Drawings and/or as required.
- E. GLAZING GASKETS
 1. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
 - a. Neoprene, ASTM C 864.
 - b. EPDM, ASTM C 864.
 - c. Thermoplastic polyolefin rubber, ASTM C 1115.
 - d. Any material indicated above.
 2. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 - a. Neoprene.
 - b. EPDM.
 - c. Thermoplastic polyolefin rubber.
 - d. Any material indicated above.
- F. GLAZING SEALANTS
 1. General: Provide products of type indicated, complying with the following requirements:
 - a. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - b. 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.
 - c. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - d. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
 2. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - a. Single-Component Neutral and Basic Curing Silicone Glazing Sealants:
 - 1) Products:

- 2) Dow Corning Corporation; 790.
- 3) GE Silicones; SilPruf LM SCS2700.
- 4) Tremco; Spectrem 1 (Basic).
- 5) Sonneborn, Div. of ChemRex, Inc.; Omniseal.
 - b. Type and Grade: S (single component) and NS (non-sag).
 - c. Class: 50.
 - d. Use Related to Exposure: NT (non-traffic).
 - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - 1) Use O Glazing Substrates: Anodic aluminum.

G. GLAZING TAPES

1. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - a. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - b. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
2. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
 - a. Type 1, for glazing applications in which tape acts as the primary sealant.
 - b. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

H. MISCELLANEOUS GLAZING MATERIALS

1. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
2. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
3. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
4. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
5. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
6. Cleaners: Type recommended by gasket manufacturer.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed, and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the glazing until unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Measure openings and cut glass accurately to fit each opening with minimum edge clearances and bite on glass as specified by FGMA. If glass is to be cut to size at Project

site, deliver each piece to Project at least 2" larger (in both dimensions) than required, to facilitate the cutting of clean-cut edges without the necessity of seaming and nipping.

1. Do not attempt to cut, seam, nip, and abrade glass which is tempered, heat strengthened, and coated.
- B. Clean glazing stops and rabbets to receive glazing materials of obstructions and deleterious substances which might impair the work.

3.2 INSTALLATION

A. PREPARATION

1. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. GLAZING, GENERAL

1. 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.
2. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
3. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
4. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
5. 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.
6. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
7. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
 - a. 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.
 - b. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
8. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
9. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
10. 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.
11. Square cut wedge-shaped gaskets at corners and install gaskets in a manner and butt joints with sealant recommended by gasket manufacturer.

C. TAPE GLAZING

1. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
2. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

3. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
 4. 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.
 5. Do not remove release paper from tape until just before each glazing unit is installed.
 6. Apply heel bead of elastomeric sealant.
 7. 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.
 8. Apply cap bead of elastomeric sealant over exposed edge of tape.
- D. GASKET GLAZING (DRY)
1. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 2. 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.
 3. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 4. Install gaskets so they protrude past face of glazing stops.
- E. SEALANT GLAZING (WET)
1. 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.
 2. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
 3. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- F. LOCK-STRIP GASKET GLAZING
- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.3 ADJUSTING AND CLEANING

- A. Protect glass from breakage immediately upon installation. Use streamers or ribbons suitably attached to framing and held free of the glass. Warning markings shall not be applied directly to the glass.
- B. Remove and replace glass which is broken, cracked, chipped, or damaged in any way and from any source, including vandalism and accidents during the construction period.
- C. Maintain glass in a reasonably clean condition during construction so that it will not become stained.
- D. Wash and polish glass on all faces just prior to final acceptance. Comply with instructions and recommendations of the glass manufacturer for cleaning.

SECTION 09250 – GYPSUM WALLBOARD**PART 1 GENERAL****1.0 SECTION INCLUDES**

- A. Non-load bearing steel studs.
- B. Gypsum wallboard.
- C. Metal suspension system.
- D. Accessories and joint materials.

1.1 RELATED SECTIONS

- A. Section 06100 – Rough Carpentry
- B. Section 09300- Ceramic Tile

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 01340:
 - 1. Manufacturer's Literature: Materials description and recommended installation instructions for systems used.

1.3 QUALITY ASSURANCE

- A. Gypsum wallboard construction shall comply with laws, ordinances, rules, regulations and orders of governing authorities having jurisdiction over this part of the Work.
- B. To the greatest extent possible, obtain materials from 1 (one) manufacturer to promote single source responsibility.
- C. Where gypsum drywall systems with fire-resistance ratings are indicated and where required to comply with governing regulations, provide materials and installations identical with applicable assemblies which have been tested and listed by recognized authorities, including UL., FM and A.I.A.
- D. Comply with the provisions of the following codes, specifications and standards except where more stringent requirements are shown on the Drawings or specified herein:
 - 1. Gypsum Association (GA) "Recommended Specifications for the Application and Finishing of Gypsum Wallboard," GA-216, unless otherwise specified herein.
 - 2. Gypsum Association (GA) "Recommended Specification: Levels of Gypsum Board Finish" GA-214 jointly published by AWCI, CISCA, GA, and PDCA.
 - 3. ASTM C645 "Standard Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board".
 - 4. ASTM C754 "Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum".

1.4 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in their original, unopened containers or bundles and stored in a place providing protection from damage and exposure to the elements. Damaged and otherwise unsuitable material, when so determined, shall be immediately removed from the Project site.

1.5 PROJECT CONDITIONS

- A. For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degrees F. For adhesive attachment and finishing of gypsum board maintain not less than 50 degrees F. for 48 hours prior to application and continuously thereafter until drying is complete. Installation shall not be started until windows are glazed, doors

installed and openings temporarily closed. Ventilation shall be provided to remove excess moisture during joint treatment.

PART 2 PRODUCTS

2.0 MATERIALS

- A. Gypsum Wallboard: Tapered edge, 5/8" thick.
 - 1. Regular: ASTM C36
 - a. Provide high-abuse as noted on drawings.
 - 2. Type X (Fire rated): ASTM C36
 - 3. Water-Resistant Gypsum Wallboard: ASTM C 630, and as follows:
 - a. Type: Regular, unless otherwise indicated.
 - b. Thickness: 5/8" unless otherwise specified.
- B. Screws: Type S and S-12 buglehead and panhead, sized to suit thickness.
 - 1. Corrosion resistant treated, or stainless steel.
- C. Adhesive: As recommended by the gypsum wallboard manufacturer.
- D. Backer Plates: 20 gauge, galvanized per ASTM B633, Type RS or heavier, sizes as required, for fastening to channels for attachment of fixtures, accessories, and similar items. Refer to Drawings, provide solid wood blocking if so indicated.
- E. Accessories: Corner reinforcements, casing beads and metal trim, fabricated from .012" (minimum) galvanized sheet steel with perforated flanges, designed to receive joint compound.
- F. Control Joints: Roll-formed zinc, or extruded vinyl as standard with the wallboard manufacturer.
- G. Joint Treatment Materials: ASTM C475.

2.1 MANUFACTURERS

- A. Steel Framed Gypsum Drywall:
 - 1. "Gypsum Wallboard" (Georgia-Pacific Corp.).
 - 2. "Gypsum Wallboard Construction" (Gold Bond Building Products Div., National Gypsum Co.).
 - 3. "Gypsum Drywall" (United States Gypsum Co., USG Corp.).

PART 3 EXECUTION

3.0 INSTALLATION

- A. Wallboard:
 - 1. Install acoustical insulation as indicated, prior to gypsum board unless readily installed after board has been installed.
 - 2. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 1' -0" in alternate courses of board.
 - 3. Install ceiling boards in the direction and manner which will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 1' -0".
 - 4. Install wall/partition boards perpendicular to framing (long edges of board perpendicular to framing members).
 - a. Where double-layer application is shown for fire-resistive rated assemblies, fasten both base layers and face layers separately to supports with screws. Install base layer perpendicular to framing members and face layer parallel to framing member.
 - b. Gypsum board joints at openings shall be located so that no joint will align with edges of opening unless control joints will be installed at these points.

5. Install exposed gypsum board with face side out. Do not install imperfect, damaged and damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.
 6. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field cut ends. not place tapered edges against cut edges and ends. Stagger vertical joints over different studs on opposite sides of partitions.
 7. Attach gypsum board to framing and blocking as required for additional support at openings and cutouts.
 8. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.
 9. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (e.g. above ceilings).
 10. Space fasteners in gypsum boards in accordance with GA-216 and manufacturer's recommendations, except as otherwise indicated.
 11. Wall Tile Base: Where drywall is base for thin-set ceramic tile and similar rigid applied wall finishes, install water resistant gypsum wallboard.
 12. Install gypsum board to radiused surfaces furring or framing in accordance with manufacturers recommendations for thicknesses shown. Moistening the face and back papers thoroughly allowing water to soak into the core of the board may be used as a method to obtain radii shorter than published recommendations.
 13. Laminate gypsum wallboard to masonry and concrete surfaces in accordance with wallboard manufacturer's instructions using recommended adhesives.
- B. Accessories:
1. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations
 - a. Install metal corner beads at external corners of drywall work.
 - b. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi-finishing type is indicated.
- C. Wallboard Finishing:
1. General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration. Prefill open joints, rounded and beveled edges, if any, using type of compound recommended by manufacturer.
 - a. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.
 - b. Sand after last coat, between coats if necessary to produce desired finish.
 - c. Wallboard finishing including joint treatment and nail or screw dimple treatment shall be complete to finished floor.
 2. Levels of finishing shall comply with those established by reference in GA-214.

3.1 PROTECTION

- A. Advise Contractor of required procedures for protecting gypsum drywall work from damage and deterioration during remainder of construction period.
- 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, moisture, or mold damaged include, but are not limited to, discoloration, sagging, fuzzy or irregular shape.

SECTION 09510 - ACOUSTIC PANEL CEILINGS**PART 1 GENERAL****1.1 GENERAL REQUIREMENTS**

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

- A. Work of this Section includes all labor, materials, equipment and services necessary to complete the acoustic panel ceilings as shown on the drawings and/or specified herein, including but not limited to, the following:
 - 1. Acoustical panel units.
 - 2. Exposed "T" suspension system, including hangers and inserts.
 - 3. Provisions for the installation of lighting fixtures, diffusers, grilles and similar items provided under other Sections.
 - 4. Cutting, drilling, scribing and fitting as required for electro-mechanical penetrations.
 - 5. Perimeter and column moldings, trim and accessories for acoustical ceilings.

1.3 RELATED SECTIONS

- A. Section 05310 - Steel Deck.
- B. Section 09250 - Gypsum Wallboard, for drywall ceilings.
- C. Division 23 - Diffusers, grilles and related frames.
- D. Division 26 - Lighting fixtures.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations published by the Ceilings and Interior Systems Construction Association (CISCA).
- B. Qualifications of Installers
 - 1. The suspended ceiling subcontractor shall have a record of successful installation of similar ceilings acceptable to Architect and shall be currently approved by the manufacturer of the ceiling suspension system.
 - 2. For the actual fabrication and installation of all components of the system, use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.
- C. The work is subject to the following standards:
 - 1. ASTM C 635 "Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings," American Society for Testing and Materials.
 - 2. ASTM C 636 "Standard Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels," American Society for Testing and Materials.
- D. In addition to suspension system specified, provide seismic struts and seismic clips to meet seismic standards as required by prevailing Codes and Ordinances.

1.5 SUBMITTALS

- A. Shop Drawings: Submit completely dimensioned ceiling layouts for all areas where acoustical ceilings are required, showing:
 - 1. Any deviations from Architect's reflected ceiling plan layouts, especially lighting fixture and dimensions. Also indicate if any light fixtures will not fit into Architect's ceiling layout due to dimensional restrictions of field conditions.

2. Direction and spacing of suspension members and location of hangers for carrying suspension members.
3. Direction, sizes and types of acoustical units, showing suspension grid members, and starting point for each individual ceiling area.
4. Moldings at perimeter of ceiling, at columns and elsewhere as required due to penetrations or exposure at edge of ceiling tiles.
5. Location and direction of lights, air diffusers, air slots, and similar items in the ceiling plane.
6. Details of construction and installation at all conditions.
7. Materials, gauges, thickness and finishes.
- B. Samples and Product Literature: Submit the following samples and related manufacturer's descriptive literature.
 1. Twelve (12) inch long sample of each components of suspension systems, including moldings.
 2. Acoustical units - full size.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

- A. Do not install acoustical ceilings until wet-work in space is completed and nominally dry, work above ceilings has been completed, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.8 COORDINATION

- A. Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, fire suppression system components, and partition system.

1.9 EXTRA STOCK

- A. Extra Stock: Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.
 1. Acoustical Ceiling Units: Furnish quantity of full size units equal to 2.0% of amount installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

- A. Provide 3/4" thick, 24" x 24" mineral fiber panels equal to "Cirrus," No. 574 with square edge, as manufactured by Armstrong World Industries, or equal made by Roxul Rockfon or USG Interiors, Inc. Panels shall have factory applied white finish with light reflectance value of 0.83. Panels shall meet ASTM E 1264, Type III, Form 1, Pattern E I, Class A, with a UL flame spread rating of 0-25.

2.2 SUSPENSION SYSTEM

- A. Provide exposed "T" suspension system, steel, with low sheen white baked enamel finish equal to "Prelude," 15/16" exposed tee 2-way grid system made by Armstrong World Industries, or equal made by USG Interiors, Inc. or Chicago Metallic Corp.
- B. The suspension system shall support the ceiling assembly shown on the drawings and specified herein, with a maximum deflection of 1/360 of the span, in accordance with ASTM C 635.
- C. Provide min. 12 ga. galvanized wire hangers, soft annealed steel conforming to ASTM A 641, prestretched, Class 1 zinc coating, soft temper, size so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire.
- D. Provide ceiling clips and inserts to receive hangers, type as recommended by suspension system manufacturer, sizes for pull-out resistance of not less than five (5) times the hanger design load, as indicated in ASTM C 635.
- E. Suspension systems shall conform to ASTM C 635, intermediate duty.
- F. Provide manufacturer's standard wall moldings with off-white baked enamel finish to match suspension systems. For circular penetrations of ceilings, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 EXECUTION**3.1 INSPECTION**

- A. Examine the areas where acoustic panel ceilings are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the layout.

3.2 PREPARATION

- A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.
- B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

- A. Codes and Standards: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations and industry standards.
- B. Install suspension systems to comply with ASTM C 636, with wire hangers supported only from building structural members. Locate hangers not more than 6" from each end and spaced 4'-0" along direct-hung runner, leveling to tolerance of 1/8" in 12'-0".
- C. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.
- D. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, reinforcing, countersplaying or other equally effective means.
- E. Install edge moldings at edges of each acoustical ceiling area, and at locations where edge of acoustical units would otherwise be exposed after completion of the work.
 - 1. Secure moldings to building construction by fastening through vertical leg. Space holes not more than 3" from each end and not more than sixteen (16) inches o.c. between end holes. Fasten tight against vertical surfaces.

2. Level moldings with ceiling suspension system, to a level tolerance of 1/8" in 12'-0".
- F. Install acoustical units in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
- G. Install hold-down clips in toilet areas, and in areas where required by governing regulations; space 2'-0" o.c. on all cross tees.
- H. Light fixtures or other ceiling apparatus shall not be supported from main beams or cross tees if their weight causes the total load to exceed the deflection capability of the ceiling suspension system. In such cases the load shall be supported by supplemental hangers furnished and installed by this Section of work.
- I. Where fixture or ceiling apparatus installation causes eccentric loading on runners, provide stabilizer bars to prevent rotation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of acoustical ceilings, including trim, edge molding, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

SECTION 09651 – RUBBER WALL BASE**PART 1 GENERAL****1.01 GENERAL PROVISIONS**

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Resilient wall base and accessories.
 - 2. Substrate preparation.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 03300 CAST-IN-PLACE CONCRETE for concrete substrate; slab surface tolerances.
 - 2. Section 06100 ROUGH CARPENTRY for plywood substrate and surface tolerances.
- C. References (Industry Standards):
 - 1. ASTM International (ASTM):
 - a) ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
 - b) ASTM E648 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
 - c) ASTM E662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 - d) ASTM F710 Standard Practice for Preparing Concrete to Receive Resilient Flooring
 - e) ASTM F1861 Standard Specification for Resilient Wall Base
 - f) ASTM F386 Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces
 - 2. Canadian ULC Standards (CAN/ULC):
 - a) CAN/ULC-S102.2 Surface Burning Characteristics
 - 3. National Fire Protection Association (NFPA):
 - a) NFPA 253 Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source
 - b) NFPA 258 Test Method for Specific Density of Smoke Generated by Solid Materials
 - c) NFPA 255 Test Method of Test of Surface Burning Characteristics of Building Materials

1.03 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- B. Product Data: Submit manufacturer's technical data sheet, care & maintenance document, submittal and/or warranty for each material and accessory proposed for use (available at www.roppe.com).
- C. Samples: Submit representative samples of each product specified for verification.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide resilient flooring materials manufactured in the United States of America by a firm with a minimum of 10 years' experience with resilient flooring materials of type equivalent to those specified.
 - 1. Manufacturer's quality management system must have ISO 9001:2000 approval.
 - 2. Provide resilient flooring products, including wall base, accessories and subfloor preparation products from one manufacturer to ensure color matching and compatibility.
 - 3. Manufacturer shall be capable of providing technical training and technical field service representation.
- B. Installer Qualifications: Installer must be professional, licensed, insured and acceptable to manufacturer of resilient flooring materials. Project Managers or Field Supervisors must be INSTALL (International Standards & Training Alliance) certified, CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager) for the requirements of the project.
- C. Sustainable Design Requirements:
 - 1. Construction waste take back program for the purpose of reducing jobsite waste by taking back uninstalled waste flooring. Information is available at <https://roppe.com/impact/>.
 - 2. Wall base and accessories that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.
 - 3. Supply all required products that are CA 01350 compliant.
 - 4. Wall base and accessories that are free of materials known to be teratogenic, mutagenic or carcinogenic.
 - 5. Wall base and accessories that contain no polyvinyl chloride or plasticizers.
 - 6. Wall base and accessories that contain no halogens.
 - 7. Wall base and accessories that contain no asbestos.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.
- B. Deliver materials sufficiently in advance of installation to condition materials to the required temperature for 48-hours prior to installation.

1.06 PROJECT CONDITIONS

- A. Maintain temperature and humidity at service levels or the ambient temperature must remain steady ($\pm 10^{\circ}$ F) and be between 65° F and 85° F for at least 48-hours prior to, during and after installation. The ambient relative humidity is recommended to be between 40% and 65% RH; avoid dew point conditions.

1.07 WARRANTY

- A. Provide manufacturer's standard limited commercial warranty to cover manufacturing defects.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Basis-of-Design: Roppe Corporation, 1602 N Union St., Fostoria, OH 44830. P: (800) 537 – 9527
- B. Substitutions: No substitutions permitted.

2.02 RESILIENT WALL BASE

A. Sculptured Rubber Wall Base:

1. Product Name: Material Specification: ASTM F1861 2. Material Height: 3. Material Thickness: ASTM F386 4. Material Length: 5. Limited Warranty: 6. Material & Composition: 7. Color: 8. Surface Burning ASTM E84/NFPA 255 9. Flammability/Critical Radiant Flux: ASTM E648 / NFPA 253 10. Smoke Density: ASTM E662/NFPA 258 11. Surface Burning: CAN/ULC-S102.2 12. Substrate Preparation:	Contours Type TP - rubber, thermoplastic Group 2 – layered (multiple layers) Style A – Straight, Style B – Cove, Style D – Sculptured 3" (76.2 mm), 4" (101.6 mm), 4 1/4" (107.95 mm), 4 1/2" (114.3 mm), 4 5/8" (117.47 mm), 5 1/2" (139.7 mm), 6" (152.4 mm), 6 1/4" (158.75 mm), 7 3/4" (196.85 mm) 1/4" (6.35 mm), 3/8" (9.53 mm) 8' (2.44 mm) sections, 40' per carton 1 year, Manufacturing Only Unique blend of a thermoplastic and rubber backing covered with a durable colored top layer. 70 standard color Class A Class 1 (>0.45 Watts per sq. cm.), .082 W/cm2 Passes (<450), 157 (flaming) - 197 (non-flaming) FSR 50, SDS 175 Per ASTM F710 and Roppe Technical Data Sheet

2.03 INSTALLATION PRODUCTS:

A. Acrylic Adhesives

1. Product Name: Product Description: Product Usage: 2. Product Name: Product Description: Product Usage: 3. Product Name: Product Description: Product Usage:	WB-600 Acrylic Wall Base Adhesive For standard, interior wall base installations over porous substrates only. AW-510 Acrylic Wet-Set Adhesive For interior wall base installations that require a more aggressive bond over porous substrates only C-630 Water-Based Contact Adhesive For interior wall base installations that require a more aggressive bond over porous or non-porous substrates.

2.04 MAINTENANCE PRODUCTS:

A. Cleaners

1. Product Name: Product Description: Product Usage:	NC-900 All-Purpose pH Neutral Cleaner For initial, daily or routine maintenance and spot cleaning.

2.	Product Name:	PR-930
	Product Description:	Performance Finish Remover
	Product Usage:	For removal of finish that has been accidentally or erroneously applied to material.

PART 3 EXECUTION

3.01 General

- A. General Contractor Responsibilities:
 - 1. Supply a safe, climate controlled building and subfloor as detailed in Roppe Technical Data Sheets.
 - 2. Ensure substrate meets the requirements of ASTM F710, Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
 - 3. Confirm the porosity of all substrates to ensure proper adhesive usage.
 - 4. Provide a secure storage area that is maintained permanently or temporarily at normal operating temperature and humidity conditions (except walk in freezers or similar) between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the flooring, so the flooring contractor can acclimate the flooring materials per manufacturer's instructions.
 - 5. Provide an installation area that is weather tight and maintained either permanently or temporarily at ambient service temperature and humidity (except walk in freezers or similar), normal operating temperature and humidity conditions (except walk in freezers or similar) between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the flooring per the manufacturer's instructions.
 - 6. Ensure areas with direct prolonged exposure to sunlight are protected with protective UVA/UVB restrictive coatings or films.
 - 7. Areas where the base are installed that are subject to direct sunlight through doors or windows should have them covered using blinds, curtains, cardboard or similar for the time of the installation and 72-hours after the installation to allow the adhesive to cure. Note: These areas should be installed using wet adhesives only.
 - 8. Conduct initial maintenance prior to final usage per the Roppe Care & Maintenance Documents. Do not conduct initial maintenance until adhesive has cured per the adhesive technical data.
- B. Flooring Contractor Responsibilities:
 - 1. Provide trained installers that are professional, licensed, insured and acceptable to manufacturer of resilient flooring materials.
 - 2. Ensure installers or installation teams meet one of the following requirements:
 - a) Have completed INSTALL (International Standards & Training Alliance) or CFI (Certified Floorcovering Installers) training programs and/or are certified by INSTALL or CFI.
 - b) Are being supervised by Project Managers or Field Supervisors that are INSTALL (International Standards & Training Alliance) certified, CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager).
 - 3. Follow all requirements in the appropriate Roppe and/or Excelsior Technical Data Sheets, Care & Maintenance Documents, Warranties and other technical documents or instructions.

3.02 EXAMINATION

- A. General: Follow guidelines laid out in Division 01, Section 017100 – Examination and Preparation, as well as Section 014300 – Quality Assurance.

- B. Verification of Conditions: Inspect all substrates to ensure they are clean, smooth, permanently dry, flat, and structurally sound.

3.03 SUBSTRATE PREPARATION

- A. General: Follow guidelines laid out in Division 01, Section 017100 – Examination and preparation. All work required to ensure substrate or subfloor meets manufacturers guidelines are the responsibility of the general contractor.
- B. Preparation: Ensure substrate meets the requirements of ASTM F710, Roppe Technical Data Sheets and Excelsior Technical Data Sheets. Substrates must be free of visible water or moisture, dust, sealers, paint, sweeping compounds, curing compounds, residual adhesives and adhesive removers, concrete hardeners or densifiers, solvents, wax, oil, grease, asphalt, visible alkaline salts or excessive efflorescence, mold, mildew and any other extraneous coating, film, material or foreign matter.

3.04 INSTALLATION

- A. General: Follow all relevant guidelines detailed in Division 01, as well as flooring and adhesive manufacturer's technical data sheets.
- B. Interface With Other Work: If caulking or sealing is required after installation, please contact the manufacturer for a suitable, matching caulk.

3.05 CLEANING & MAINTENANCE

- A. General: Clean up installation area and sweep, dust or wipe material to remove any dirt, dust or debris.
- B. Initial Maintenance: Conduct initial maintenance per the manufacturer's Care & Maintenance documents (www.roppe.com).

3.06 CLOSEOUT ACTIVITIES

- A. General: Follow all federal, state and local requirements and Division 01 Section 017600 – Protecting Installed Construction and Section 017800 – Closeout Submittal requirements for these activities.
- B. Protection: Protect newly installed material with construction grade paper or protective boards, such as Masonite or Ram Board, to protect material from damage by other trades. Limit usage and foot traffic according to the adhesive's requirements. When moving appliances or heavy furniture, protect wall base from scuffing and tearing using temporary floor protection.

SECTION 09901 - CORROSION PROTECTION**PART 1 GENERAL****1.0 DEFINITION**

- A. This specification covers the requirements governing the selection and application of the coating system to be used on the pit steel components, open steel staircases, and miscellaneous structural steel susceptible to corrosion.

1.2 GENERAL

- A. The following surfaces are not required to be coated:
 - 1. Prefinished aluminum metals
 - 2. Product tubing, air lines, water lines, conduit, etc.
 - 3. Nameplates, machined surfaces, instrument glass, flanged faces, control valve stems and similar items.
 - 4. Ferrous metals not susceptible to corrosion.

1.3 WARRANTY

- A. Contractor shall guarantee that the application fulfills all conditions as stated in the Corrosion Protection specifications. Should any workmanship covered by these specifications be proven defective within the guarantee period, of 3 years, Contractor shall repair or replace the workmanship without charge to Owner.
- B. The product manufacturer shall guarantee that the materials satisfactorily perform for a period of 3 years. Should any materials covered by these specifications be proven defective within the guarantee period, of 3 years, the product manufacturer shall repair or replace the workmanship without charge to Owner.
- B. Any deviation from this specification shall be approved in writing by Company. Failure of applicator to consult with Owner representative to clarify any item in the specification will in no way relieve the Contractor of his responsibility for satisfactory compliance with these specifications.

1.4 CODES AND STANDARDS

The Fabricator shall comply with the applicable provisions of the following specifications:

- A. Steel Structural Painting Council (SSPC)
 - PA-1 Shop, Field and Maintenance Painting
 - SP-1 Solvent Cleaning
 - SP-2 Hand Tool Cleaning
 - SP-3 Power Tool Cleaning
 - SP-5 White Metal Blast Cleaning (NACE No. 1)
 - SP-6 Commercial Blast Cleaning (NACE No. 2)
 - SP-7 Brush-Off Blast Cleaning
 - SP-10 Near White Blast Cleaning (NACE No. 2)
- B. American Society for Testing and Materials (ASTM)
 - A-90 Weight of coating on zinc-coated (galvanized) iron and steel articles.
 - A-120 Black and hot dipped zinc-coated (galvanized) welded and seamless steel pipe for ordinary users.
 - A-123 Zinc (hot-galvanized) coatings on product fabricated from rolled, pressed, and forged steel shapes, plates, bars and strip.
 - A-143 Safeguarding against embrittlement of hot galvanized structural steel products.
 - A-153 Zinc coating (hot dip on iron and steel hardware).
 - A-164 Electro deposited coatings of zinc on steel.

- A-385 Recommended practice for providing high quality zinc coatings (hot-dip) on assembled products.
- A-563 Carbon steel nuts.
- C. Pictorial Surface Preparation Standards For Painting Steel Structures
 - SSPC-SP2 Swedish Visual Std. St. 2
 - SSPC-SP3 Swedish Visual Std. St. 3
 - SSPC-SP5 Swedish Visual Std. St. 3 (NACE No. 1)
 - SSPC-SP6 Swedish Visual Std. Sa 2
 - SSPC-SP7 Swedish Visual Std. Sa 1
 - SSPC-SP10 Swedish Visual Std. Sa 2-1/2 (NACE No. 2)

1.5 QUALITY ASSURANCE

- A. All work and materials applied under this specification shall be subject to inspection by Owner representative.
- B. If deemed necessary, the Owner may elect to test each coat of paint for dry film thickness (d.f.t.) using a dry film gauge of the Mikrotest type or an approved equivalent. The U.S. Bureau of Standards Precise Film Thickness Card shall be used to calibrate the instrument prior to its use.
- C. All surfaces to which coatings are applied shall be free of dirt, grease, chemicals, and other contamination.
- D. The completed coating shall be inspected by the Owner's representative for runs, overspray, and roughness, holidays and any signs found to show these or other evidence of improper application shall require repair or recoating in accordance with the manufacturer's recommendations at Contractor's expense.

PART 2 PRODUCTS

- A. MANUFACTURER
 - Sherwin Williams Corothane I Preprime
 - Sherwin Williams Epoxy Mastic Aluminum II
 - Sherwin Williams Acrolon 218 HS

2.1 PERFORMANCE CHARACTERISTICS

- A. Sherwin Williams Corothane I Preprime
 - 1. Abrasion Resistance:
 - Method: ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load
 - Result: 88 mg loss
 - 2. Direct Impact Resistance:
 - Method: ASTM D2794
 - Result: 40 in. lbs.
 - 3. Flexibility:
 - Method: ASTM D522, 180° bend, 1/8" mandrel
- B. Sherwin Williams Epoxy Mastic Aluminum II
 - 1. System Tested: (unless otherwise indicated)
 - Substrate: Steel
 - Surface Preparation: SSPC-SP6
 - Finish: 1 ct. Epoxy Mastic Aluminum II
 - @ 5.0 mils dft/ct
 - 2. Abrasion Resistance:
 - Method: ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load
 - Result: 124 mg loss
 - 3. Adhesion:
 - Method: ASTM D4541
 - Result: 1000+ psi
 - 4. Direct Impact Resistance:

- Method: ASTM D2794, 1/4" steel
Result: 160 in. lbs.
5. Dry Heat Resistance:
Method: ASTM D2485
Result: 200°F
 6. Exterior Durability:
Method: 1 year 45° South
Result: Excellent, chalks
 7. Flexibility:
Method: ASTM D522, 180° bend, 3/4" mandrel
Result: Passes
 8. Moisture Condensation Resistance:
Method: ASTM D4585, 100°F, 1500 hours
Result: No blisters, rust, or delamination
 9. Pencil Hardness:
Method: ASTM D3363
Result: 2H
 10. Salt Fog Resistance:
Method: ASTM B117, 1000 hours
Result: No blistering, cracking, softening, or delamination.
 11. No more than 1/8" rust creepage.
Rating 10 per ASTM D610 for rusting.
- C. Sherwin Williams Acrolon 218 HS
1. System Tested: (unless otherwise indicated)
Substrate: Steel Surface Preparation: SSPC-SP10
1 ct. Macropoxy 646 @ 6.0 mils dft
1 ct. Acrolon 218 HS Gloss @ 4.0 mils dft
 2. Abrasion Resistance: 1
Method: ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load
Result: 43 mg loss
 3. Adhesion:
Method: ASTM D4541
Result: 975 psi
 4. Corrosion Weathering: 2
Method: ASTM D5894, 9 cycles, 3024 hours
Result: Rating 10 per ASTM D610, for rusting
 5. Rating 10 per ASTM D714, for blistering
Direct Impact Resistance: 1
Method: ASTM D2794
Result: 50 in. lb.
 6. Dry Heat Resistance: 1
Method: ASTM D2485, Method A
Result: 200°F
 7. Flexibility: 1
Method: ASTM D522, 180° bend, 1/8" mandrel
Result: Passes
 8. Humidity Resistance: 2
Method: ASTM D4585, 100°F, 1500 hours
Result: Rating 10 per ASTM D610 for rusting
Rating 10 per ASTM D714 for blistering
 9. Pencil Hardness:
Method: ASTM D3363
Result: 3H
 10. Salt Fog Resistance: 2
Method: ASTM B117, 7000 hours
Result: Rating 10 per ASTM D610 for rusting

Rating 9 per ASTM D714 for blistering

1. Finish coat only tested
2. Primer Zinc-Clad II Plus
Intermediate Macropoxy 646
Finish Acrolon 218 HS

Meets the requirements of SSPC Paint No. 36, Level 3.

PRODUCT CHARACTERISTICS

- A. Sherwin Williams Corothane I Preprime
Finish: Semi-Gloss
Color: Clear / Amber Cast – Do not Tint
Volume Solids: 62% $\pm$ 2%
Weight Solids: 68% $\pm$ 2%
VOC (calculated): <340 g/L; 2.80 lb/gal
Recommended Spreading Rate per coat:
Wet mils: 2.5 - 3.0
Dry mils: 1.5 - 2.0
Coverage: 497 - 663 sq ft/gal approximate
Drying Schedule @ 3.0 mils wet @ 50% RH:
@55°F @ 77°F @100°F
To touch: 3 hours 1-1/2 hours 20 minutes
To recoat minimum: 8 hours 3-1/2 hours 1 hour
maximum: 30 days 30 days 15 days
To cure: 4 days 3 days 1 day
Drying time is temperature, humidity, and film thickness dependent.
Abrade surface if maximum recoat time is exceeded.
Shelf Life: 12 months, unopened
Store indoors at 40°F to 100°F.
Flash Point: 105°F, PMCC
Reducer/Clean Up: Reducer #15, R7K15
- B. Sherwin Williams Epoxy Mastic Aluminum II
Finish: Flat
Color: Aluminum
Volume Solids: 78% $\pm$ 2%, mixed
ASTM D2697 (disk method)
80% $\pm$ 2%, mixed, calculated
ASTM D5201
Weight Solids: 89% $\pm$ 2%, mixed
VOC (EPA Method 24): Unreduced: <180 g/L; 1.50 lb/gal
mixed Reduced 10%: <235 g/L; 1.96 lb/gal
Mix Ratio: 1:1 by volume
Recommended Spreading Rate per coat:
Wet mils: 5.0 - 7.5
Dry mils: 4.0 - 6.0
Coverage: 214 - 320 sq ft/gal approximate
NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.
Drying Schedule @ 7.5 mils wet @ 50% RH:
@ 35°F @ 50°F @ 77°F @ 120°F
To touch: 20 hours 10 hours 2½ hours 1 hour
Tack free: 60 hours 24 hours 5 hours 3 hours
To recoat:
minimum: 4 days 24 hours 6 hours 3 hours
maximum: 1 year 1 year 1 year 1 year
To cure: 21 days 21 days 10 days 7 days
Pot life: 6 hours 5 hours 3 hours 1½ hours
Sweat-in-time: 45 minutes 30 minutes 15 minutes 10 minutes

If maximum recoat time is exceeded, abrade surface before recoating.

Drying time is temperature, humidity, and film thickness dependent.

Shelf Life: 12 months, unopened

Store indoors at 40°F to 100°F

Flash Point: 102°F, PMCC, mixed

Reducer/Clean Up: Below 80°F - Xylene, R2K4

Above 80°F - Reducer #100, R7K100

C. Sherwin Williams Acrolon 218 HS

Finish: Semi-Gloss

Color: Valvoline Red

Volume Solids: 65% ± 2%, mixed, may vary by color

Weight Solids: 78% ± 2%, mixed, may vary by color

VOC (EPA Method 24): Unreduced: <300 g/L; 2.5 lb/gal

mixed Reduced 10%: <340 g/L; 2.8 lb/gal

Mix Ratio: 6:1 by volume, 1 gallon or 5 gallon mixes

premeasured components

Recommended Spreading Rate per coat:

Wet mils: 4.5 - 9.0

Dry mils: 3.0 - 6.0

Coverage: 175 - 346 sq ft/gal approximate

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Drying Schedule @ 6.0 mils wet @ 50% RH:

@ 50°F @ 77°F @ 120°F

To touch: 2 hours 30 minutes 20 minutes

To handle: 10 hours 6 hours 4 hours

To recoat:

minimum: 12 hours 8 hours 6 hours

maximum: 3 months 3 months 3 months

To cure: 14 days 7 days 5 days

Drying time is temperature, humidity, and film thickness dependent.

Pot Life: 4 hours 2 hours 45 minutes

(reduced 5% with Reducer R7K15)

Sweat in Time: none none none

If maximum recoat time is exceeded, abrade surface before recoating.

Shelf Life: Part A: 36 months, unopened

Part B: 12 months, unopened

Store indoors at 40°F to 100°F

Flash Point: 55°F, Seta, mixed

Reducer/Clean Up: Spray Reducer R7K15

Brush/Roll Reducer #132, R7K132

PART 3 EXECUTION

3.0 PREPARATION

- A. All local mounted instruments, gauges, nameplates, control valve stems, code stamps, and electrical fixtures shall be protected to prevent damage during blasting and painting. Nameplates, which are attached in a manner that will allow corrosion to occur behind the nameplate, shall be removed prior to waterblasting and painting and then reattached after painting is completed.
- B. Use low moisture steam cleaning to remove grease, oil, and any other foreign contamination from the surface of all steel & concrete. Solvent cleaning may be necessary between coats to remove recontamination.

- C. All abrasive material will be absolutely clean and dry. Filters necessary to accomplish this will be provided in the compressors and elsewhere as needed. No oil and no moisture of any kind will be acceptable.
- D. All oil and/or grease contaminations shall be removed by solvent washing SSPC-SP-1-63 "solvent cleaning" before starting water blasting.
- E. Coating and curing shall be done in such a manner to anticipate that the coating will be able to cure for a minimum of six hours at relative humidity less than 85%.
 - 1. Complete curing and maximum chemical resistance of the coating may take up to 7 days at 77 degrees F.
- F. No water blasting shall be permitted on copper surfaces, control valves and electric motor drivers. All oil/grease, dirt, scale, or flaking paint, and other contamination shall be removed prior to external painting.

3.1 MIXING, THINNING AND STORAGE

- A. Paint must be kept in fully enclosed storage room within maximum and minimum temperature limitations and time restraints of storage to agree with manufacturer's recommendations. Unless more restrictive positions are given by the coating manufacturer's storage requirements, paint should be kept in fully enclosed storage at temperatures greater than 40°F, and less than maximum storage temperature as per manufacturer's recommendation.
- B. All containers of coating material shall remain unopened until required for use. Only enough containers shall be opened that will be used during one day. Any coating material remaining in a container which was opened more than 24 hours earlier will not be used.
- C. Coating materials which have jelled or otherwise deteriorated during storage shall not be used and shall be removed from site.
- D. All coating ingredients in any container shall be thoroughly and completely mixed by power-driven mixers before use to a smooth and uniform consistency. For two (2) component systems, the components, and catalyst and the coating, shall be thoroughly mixed.
- E. Coating material mixed in the original container shall not be transferred until all settled pigment is incorporated in the vehicle. This does not imply that part of the vehicle may not be poured off temporarily to simplify the mixing.
- F. Coating material shall not be mixed or kept in suspension by using a bubbling air stream.
- G. Where a skin has formed in the container, the skin shall be cut loose and discarded. If such skins are sufficiently thick to have a practical effect on the composition and quality, the paint shall not be used.
- H. All pigmented material shall be strained after mixing except where application equipment is provided with adequate strainers. Strainers shall be capable of passing the pigment and removing any skin.
- I. Material which does not have a limited pot life, or does not deteriorate on standing may be mixed any time before using, but if settling has occurred, material shall not remain in spray pots or buckets overnight but shall be gathered into a closed container and remixed before use.
- J. No thinner shall be added unless necessary for proper application. Thinning shall not exceed limitations established by manufacturer.
- K. Type of thinner shall comply with manufacturer's instruction.
- L. When use of thinner is permissible, it shall be added during the mixing process. Painters shall not add thinner after paint has been thinned to the proper consistency. All thinning shall be done under supervision of one acquainted with the correct amount and type to be added.

PREPARATION

- A. Work shall be performed off-site to the extent possible.
- B. General Surface Preparation
 - 1. Minimum surface preparation is Hand Tool Clean per SSPCSP2.
 - 2. Clean all surfaces an abrasive method as recommended by the manufacturer for the specific application.
 - 3. When surfaces are thoroughly clean, dry and contaminant free, prime any bare steel within 8 hours or before.
- C. Sherwin Williams Corothane I Preprime
 - 1. Surface Preparation:
 - a. Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.
 - b. Refer to product Application Bulletin for detailed surface preparation information.
 - c. Minimum recommended surface preparation: Iron & Steel: SSPC-SP2 or SP3
 - 2. Application Conditions:
 - a. Temperature: air and surface: 20°F minimum, 100°F maximum material: 45°F minimum
 - b. Do not apply over surface ice
 - c. Relative humidity: Can be applied at relative humidities up to 99%.
 - d. Refer to product Application Bulletin for detailed application information.
- D. Sherwin Williams Epoxy Mastic Aluminum II
 - 1. Surface Preparation :
 - a. Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.
 - b. Refer to product Application Bulletin for detailed surface preparation information.
 - c. Minimum recommended surface preparation:
 - 1) Iron & Steel: SSPC-SP2
 - 2) Aluminum: SSPC-SP1
 - 3) Galvanizing: SSPC-SP1
 - 2. Application Conditions:
 - a. Temperature: 35°F minimum, 120°F maximum (air, surface, and material) at least 5°F above dew point
 - b. Relative humidity: 85% maximum
 - c. Refer to product Application Bulletin for detailed application information.
- E. Sherwin Williams Acrolon 218 HS
 - 1. Surface Preparation:
 - a. Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.
 - b. Refer to product Application Bulletin for detailed surface preparation information.
 - c. Minimum recommended surface preparation:
 - 1) Iron & Steel: SSPC-SP6/NACE 3, 1-2 mils pro
 - 2) Galvanizing: SSPC-SP1
 - 3) Primer required
 - 2. Application Conditions:
 - a. Temperature: 40°F minimum, 120°F maximum (air, surface, and material) at least 5°F above dew point Relative humidity: 85% maximum

- b. refer to product Application Bulletin for detailed application information.

3.3 GENERAL COATING PROCEDURE

- A. The type, brand, number of coats, color, and thickness shall be as specified in scope of work.
- B. Primer and finish coats for any particular system shall be from the same manufacturer to ensure compatibility.
- C. Manufacturer's instructions, including safety precautions, are a part of this specification. In case of conflict, the more stringent instructions shall govern.

3.4 GENERAL COATING APPLICATION

- A. Surfaces shall be coated according to specific manufacturer's specifications. In any event, surfaces shall not be coated in rain, wind, snow, fog, mist, dust or in areas where injurious airborne elements exist.
- B. Water blast cleaned surfaces shall be coated with one complete application of primer as soon as practicable but in no case later than four (4) hours after blasting.
- C. To the maximum extent practicable, each coat of material shall be applied as a continuous film of uniform thickness free of pores. Any thick spots or areas missed on the application shall be recoated and permitted to dry before the next coat is applied, or in accordance with manufacturer's recommendation.
- D. Each coat shall be in a proper state of cure or dryness before the application of the succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the undercoat, and after the manufacturer's minimum recommended drying time has elapsed.
- E. Alternate coats shall be tinted sufficiently (if acceptable by manufacturer) to produce enough contrast to indicate complete coverage of the surface. When the paint is the color of the steel, or when the tinting of the final coat is objectionable, the first coat to be applied shall be tinted. The tinting material must not be detrimental to the service life of the paint.
- F. For each applied coat to structural shapes the edges shall receive the first pass of the coat followed directly by the coating of the remaining surfaces.

3.5 AIR SPRAY APPLICATION

- A. Owner approval is required to perform air spray application.
- B. The equipment used shall be suitable for the intended purpose, capable of properly atomizing the paint to be applied, and equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- C. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and the drain valves must be opened slightly to permit continuous draining of condensate during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
- D. Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.
- E. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of the paint, excessive evaporation of solvent, or loss by over spray.
- F. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film. Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted. Equipment shall be purged with thinner compatible with product to be sprayed.

- G. Paint shall be applied in a uniform layer, with 50% overlapping at the edge of the spray pattern. The spray pattern shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance as recommended by the paint manufacturer which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke and restarted only after forward motion of the gun has started.
- H. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- I. Areas inaccessible to the spray gun shall be painted per Section 8.4 of this specification.

3.6 BRUSH APPLICATION

- A. Coatings shall be brushed on all areas.
- B. Brushes shall be of a style and quality that will enable proper application of paint. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces, and rough or pitted steel. Wide, flat brushes are suitable for large flat areas, but they shall not have a width over five inches.
- C. The brushing shall be done so that a smooth coat as nearly uniform in thickness as possible is obtained.
- D. Paint shall be worked into all corners.
- E. Any runs or sags shall be brushed out.
- F. There shall be a minimum of brush marks in the coat of applied paint.
- G. Successive coats of paint shall be applied by crosshatching the previous coat.
- H. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskin.

3.7 GENERAL CONSIDERATION AND PROTECTION

- A. For surfaces to be painted, which cannot be abrasive blasted, remove all oil film, dirt, scale or flaking paint preferably using solvent. Where flaking paint or scale is removed, all rough edges shall be feathered. Power brushing can be used; however, care must be taken not to burnish the metal surface as paint will not then adhere. Application by means of brush or spray is acceptable using procedures as previously outlined.
- B. All nameplates, manufacturer's identification tags, instrument glass, finished flange faces, control valve stems and similar items shall be cleaned and restored to its original condition.
- C. Wet paint shall be protected against contamination from dust or other foreign matter.
- D. Paint shall be protected from rain, condensation, contamination, snow and freezing to the fullest extent practical until cured.
- E. Primer coat thickness is critical to paint system integrity and shall meet the required specification.
- F. Manufactured items such as valves and level gauges shall be coated according to this specification. Unless specifically approved by Company, manufacturer's paint system is not acceptable and therefore, Fabricator shall blast and paint the item per this specification.

3.8 DRYING OF COATED SURFACES

- A. No paint shall be force dried under conditions which will cause checking, wrinkling, blistering, formation of pores, or detrimentally affect the condition of the paint.
- B. No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint, or approved by Owner.

3.9 REPAIR OF DAMAGED PAINT SURFACES

- A. Any improperly coated surfaces shall be solvent cleaned, hand or power tool cleaned and then re-primed and painted if not completely coated.

3.10 CLEAN UP

- A. All paint brushes, sprayers, pans, rollers, etc. must be cleaned off-site.

- B. The contractor shall, at all times, keep the premises free from accumulation of waste materials or rubbish. At the completion of the work the jobsite shall be completely cleaned of any evidence of construction materials or debris.

3.11 JOINT SEALANT

- A. Upon completion of painting of pit / stair steel, cracks, crevices, and voids along the steel and concrete and ceiling of pit area should be filled with a MCU single component caulk/sealant as follows:
 - 1. This process shall begin with solvent cleaning or low moisture steam cleaning of the concrete and steel to remove all, oil, grease, dirt, and any other foreign contaminants.
 - 2. The cracks, voids, and crevices should then be cleaned out.
 - 3. Remove any loose paint, concrete, dirt, debris, etc.
 - 4. Surface must be dry, and clean before sealant is applied.
 - 5. If necessary, install foam backer rod into crevices and cracks to provide a base for the sealant.
 - 6. Fill cracks and crevices with sealant and make surface level.
 - 7. Allow first application to dry completely.
 - 8. Apply second application at a 45 degree angle to prevent ponding of any excess fluid buildup.
- B. Acceptable products:
Sika 1A NS smooth Stone MCU single component sealant or SW Stampede 1 MCU smooth NS sealant/Stone # 163-7537

SECTION 09910 – EXTERIOR PAINTING**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel.
 - 2. Galvanized metal.
 - 3. Masonry
 - 4. Asphalt and concrete driveways.
- B. Related Sections include the following:
 - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
 - 3. Division 9 Section "Staining and Transparent Finishing"

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- E. Qualification Data: For Applicator.

1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- B. 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.

1. Maintain containers in clean condition, free of foreign materials and residue.

1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 PRODUCTS

2.0 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Sherwin-Williams Company.

2.0 PAINT, GENERAL

- A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions
- C. Colors: As selected by Owner from manufacturer's full range and as noted in Paint Schedule portion of these specifications.

2.2 METAL PRIMERS

- A. All galvanized and metal surfaces shall be primed with Sherwin-William's Pro-Cryl Primer prior to application of specified finish coats.

PART 3 EXECUTION**3.0 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.1 PREPARATION

- A. Remove machined surfaces and similar items already in place that 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.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.
 - 2. Existing facilities that are to be painted must be thoroughly pressure washed prior to paint application.
- C. All galvanized and metal surfaces shall be cleaned with solvent or non-hydrocarbon cleaner as recommended by the coating manufacturer prior to priming with metal primers. Rust area shall be prepared per SSPC-SP2 or SP3 Hand or Power Tool Cleaning and
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
- E. Use only thinners approved by paint manufacturer and only within recommended limits. Any moisture problems such as roof leaks, improper grading, etc., must be corrected prior to paint application.

3.2 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the room finish schedule.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

5. 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.
- B. If the primer can be tinted, 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. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. Do not apply additional coats if previous coat has exceeded the re-coat window. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - a. All surfaces shall receive a minimum of (2) finish coats of paint according to paint manufacturer's recommendations.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion
- D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, synthetic fiber or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- E. Minimum – Maximum Coating Thickness: Apply paint materials no less than manufacturer's recommended minimum spreading rate or more than maximum per coat to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. Wainscote paint shall stop at doors and frames. Entire door and frame shall be painted one color as noted in the drawings and Paint Schedule.
- G. Apply Sher-Clear over exterior Valvoline Red paints in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance of paint materials with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces

painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.4 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 Owner, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. Refer to drawings for finishes.

REVISED 1/4/16

SECTION 09920 - INTERIOR PAINTING**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel.
 - 2. Gypsum board.
 - 3. Wood.
 - 4. Masonry
- B. Related Sections include the following:
 - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 09910 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
 - 3. Section 09901 Corrosion Protection for surface preparation, priming and paint application of steel susceptible to corrosion (ie. Pit steel, stairs, etc.).

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- E. Qualification Data: For Applicator:

1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.

- B. 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.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.

1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 PRODUCTS

2.0 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sherwin-Williams Company.

2.1 PAINT, GENERAL

- A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions
- C. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - 2. Non-flat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 - 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
- D. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with

the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop.

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
- E. Colors: Refer to finish legend on drawings.

2.2 PRIMERS/SEALERS

- A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
1. Sherwin-Williams; ProMar 200 Zero VOC Latex Wall Primer B28W2600 Series: Applied at a dry film thickness of not less than 1.6 mils.

2.3 METAL PRIMERS

- A. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
1. Sherwin-Williams; Pro-Cryl Primer B66-310 Series applied at a dry film thickness of not less than 3.0 mils. Refer to Section 09901 Corrosion Protection for steel members requiring more stringent Corrosion Protection application procedures.

2.4 WOOD PRIMERS

- A. Interior Wood Primer for Acrylic-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
1. Sherwin-Williams; Premium Wall & Wood Primer B28W8111 Series: Applied at a dry film thickness of not less than 1.6 mils.

2.5 MASONRY PRIMERS

- A. Sherwin Williams Heavy Duty Block Filler B42W46.

2.6 PLASTIC PRIMERS

- A. XIM/UMA Bonding Primer
B. Sherwin Williams Multi-Purpose Latex Primer B51W450 Series

2.7 INTERIOR FINISH COATS

- A. [High Performance ambient cured, one component acrylic coating with excellent performance properties for interior application.](#)
1. Sherwin-Williams; [SHER-CRYL™ HPA, HIGH PERFORMANCE ACRYLIC](#). Applied at a dry film thickness of not less than [2.2](#) mils.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Owner about anticipated problems when using the materials specified over substrates primed by others.
- C. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- D. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Wood: 15 percent.
 - 2. Gypsum Board: 12 percent.

3.1 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - 2. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - 1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - 2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - 3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat
- D. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents or non-hydrocarbon cleaner as recommended by the manufacturer so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- E. 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.
- F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- G. For painting over previously painted surfaces, test the surface to determine if the previously painted surface is oil or latex and utilize a manufacturer recommended primer.

- H. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.2 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces. Do not carry wainscote application through door areas. Doors and frames shall be one color as specified in the paint schedule.
 - 8. 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.
- 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. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. Do not apply additional coats if previous coat has exceeded the re-coat window. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, synthetic fiber or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- E. Minimum – Maximum Coating Thickness: Apply paint materials no less than manufacturer's recommended spreading rate or more than the maximum per coat to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- G. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - f. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 2. Electrical Work:
 - a. Panelboards.
 - b. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements

3.3 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.4 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 Owner, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. A minimum of two finish coats shall be applied.
- B. Refer to drawings for finishes.

Revised 8/15/2019

SECTION 10261 – CORNER WALL PROTECTION**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 RELATED SECTIONS

- A. Section 06640: Plastic Paneling

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Corner guards.

1.3 SUBMITTALS

- A. Samples: If requested by Owner, provide one sample for exposed finish required, as indicated below.
 - 1. Corner Guards: 6 inches long.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 PRODUCTS**2.0 MATERIALS**

- A. Stainless-Steel Sheet: ASTM A 240.
- B. Fasteners: Non-magnetic stainless-steel, or other non-corrosive metal screws, bolts, and other fasteners compatible with stainless steel corner guards being fastened.

2.1 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards: Fabricated from 1-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturers:
 - a. ARDEN Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Pawling Corporation.
 - 2. Material: Stainless steel, Type 304.
 - a. Thickness: Minimum 0.0625 inch.
 - b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 1 ¼" by 1 ¼" inches.
4. Corner Radius: 1/8 inch.
5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.2 FABRICATION

- A. Fabricate wall-protection units to comply with requirements indicated for design, dimensions, and member sizes.
- B. Provide surfaces free of dents, uneven coloration, and other imperfections. Fabricate members and fittings flush and smooth.

2.3 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Remove tool and die marks and stretch lines or blend into finish.
 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 1. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.2 INSTALLATION

- A. General: Install wall-protection corner guards plumb and true to line without distortions. Do not use materials with stains, dents, or other defects that might be visible in the finished Work.
 1. Install impact-resistant wall-protection units in locations and at mounting heights indicated on Drawings.

SECTION 10262 – BUMPER GUARDS**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 RELATED SECTIONS

- A. Section 06640: Plastic Paneling

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Bumper Guards for use on Podium corners.

1.3 SUBMITTALS

- A. Samples: If requested by Owner, provide one sample for exposed finish required, as indicated below.
 - 1. Bumper Guards: 6 inches long.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain bumper units through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store bumper guards in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 PRODUCTS**2.0 MATERIALS**

Dimensions: ext. dia. 1.5"
x 39.5" L
Color: Yellow & Black
Composition: Polyurethane
foam
Weight: 1.14 lbs.
Dimensions
(Wing): 1" W
Style: 90 degree
corner

2.1 BUMPER GUARDS

- A. Surface-Mounted, Polyurethane Foam Bumper Guards: Fabricated from 1-piece, formed or extruded foam with 90 degree.
 - 1. Manufacturers:

- a. New Pig, Inc. Contact 800-468-4647
2. Mounting: Self adhesive.

2.2 FABRICATION

- A. Fabricate wall-protection units to comply with requirements indicated for design, dimensions, and member sizes.
- B. Provide surfaces free of dents, uneven coloration, and other imperfections. Fabricate members and fittings flush and smooth.

2.3 PREPARATION

- A. Before installing the corner protectors, thoroughly remove any old bumper guard material and adhesive. Once this is complete, thoroughly clean the corner with paint thinner to remove grease and grime.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 1. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Bumper Guards shall be installed on the front of standard podium units only. Not to be used for fold-up podiums.
 1. For standard units located against a wall, only the pit side corner will require a bumper guard. For standard units located between pit openings, both front corners will require a bumper guard.
- B. Bumper Guards come in lengths of 39-1/2". Each corner protector will need to be cut in 8-1/2" lengths.
- C. The Bumper Guards should be cut neatly and squarely utilizing a sharp utility knife or Exacto knife.
- D. Remove the glue strip protection on the back of the guard material and firmly apply to the podium corner.
- E. Ensure the material is secure.

3.2 CLEANING

- A. Remove any smudges, grease, grime, etc. with products approved by manufacturer.

SECTION 10430 – EXTERIOR SIGNS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Exterior signs shall be furnished and installed by Owner. Electrical feeds, free-standing sign foundation and monument base shall be installed by the General Contractor for new ground-up projects.
- B. This Section includes the following:
 - 1. Exterior signs.
- C. Related Sections include the following:
 - 1. Division 5 "Metals"
 - 2. Division 7 "Weatherproofing"
 - 3. Division 7 "Joint Sealants"
 - 4. Division 7 "Sheet Metal Flashing and Trim"
 - 5. Division 26 Sections for electrical service and connections for illuminated signs.
 - 6. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
 - 7. Division 26 Section "Interior Lighting" for illuminated Exit signs.
 - 8. Division 31 "Earthwork"
 - 9. Division 32 Section "Landscaping"
 - 10. Division 32 "Property Improvements"

1.2 SUBMITTALS

- A. Product Data: Furnished by Owner's vendor for each type of product indicated.
- B. Shop Drawings: Provided by Owner's vendor. Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and layout for each sign.

1.3 QUALITY ASSURANCE

- A. Installers shall be noted in the industry as "A" installers and shall be approved by Owner prior to award of the work.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Survey openings, facility support structure, electrical, anchoring requirements, positioning, property boundaries, etc. by field inspection before fabrication and indicate as applicable on Shop Drawings.
- B. Notify Owner of any obstructions that may hinder full view of proposed signage.
- C. Verify Owner proposed drawings, manufacturer's shop drawings and actual project conditions. Notify Owner of any discrepancies.
- D. If the facility is currently an operating unit, schedule work with Owner to minimize disturbance to business operations. This may require after hours work if installation deters customers from easy ingress and egress. In no case shall work at operating facilities occur on a Saturday.

- E. Contractor must meet Owner's minimum insurance requirements.
- F. Prior to excavating, applicable utility companies shall approve excavation limits.
- G. Do not install heavy signs when conditions, such as weather prohibits the use of a crane.

1.5 STORAGE AND HANDLING

- A. Signs shall be covered with protective film which shall remain on the signs until installation is complete.
- B. Signs shall not be shipped loose. All signs shall be properly crated and secured for shipment. Avoid strapping signs in such a manner that may result in abrasions.
- C. Defective materials resulting from improper shipment, storage and handling shall be rejected by the Owner.
- D. The contractor shall plan shipments so as to not interfere with Owner's business operations or site construction.
- E. Identify a storage area prior to shipment that is agreed to by Owner and/or General Contractor.
 - 1. Provide adequate barricades to protect the stored materials. Lighted barricades shall be utilized if stored in drive areas on Owner's property.

1.6 WARRANTY

- A. Manufacturer's shall provide the minimum warranty requirements noted below:

Fluorescent Lamps: 1 Year

Fluorescent Ballasts – Parts: 1 Year

Fluorescent Ballasts – Labor: 2 Years

Lamp Sockets & Wiring – Material: 1 Year

Lamp Sockets & Wiring – Labor: 1 Year

Exterior Paint Finishes: 10 Years

Polycarbonate Faces - fading/yellowing/light transmission: 12 Years

Polycarbonate Faces - Breakage due to mfgs. Defect: 12 Years

3-M 3630 Series Vinyl 2nd surface (vertical) applied to solar grade
poly: 10 Years

3-M 3630 Series Southwest Area: 6 Years

Digitally Printed vinyl applied to 2nd surface: 5 Years

Manufacturer's Workmanship: 1 Year

PART 2 PRODUCTS

2.0 MANUFACTURERS

- A. The following manufacturers are approved by Owner for fabrication and installation of exterior signs:
 - 1. Fairmont Sign Company. Contact Tom Homeier @ 216-642-0044
 - 2. Federal-Heath Sign Company. Contact Matt Smith @ 770-992-9060 ext. 212
 - 3. The ICON Companies. Contact Laura Monroe @ 865-805-6001

2.0 MATERIALS

- A. 3M Translucent Vinyl
- B. 3M Opague Vinyl
- C. .090 Aluminum – sign can

- D. Akzo Nobel Paint products
- E. Pre-finished ACM metal panels by Alpolc or approved equal.
- F. Brackets and Mounting Frame.
- G. Lifting Brackets (if required)
- H. Anchors, thru-bolts, anchor bolts, etc.
- I. Bumper posts (if required)
- J. Sealants
- K. Polycarbonate sign product
- L. Digital print vinyl application
- M. Electrical components:
 - 1. T-12 – Daylight – High Output lamps
 - 2. Advance electronic ballasts

2.2 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 FABRICATION

- A. General: Provide manufacturer's standard signs based on configurations indicated in Owner drawings and/or renderings and standard design manual.
- B. Manufacturer's shop drawings must be approved by Owner with Notice to Proceed (Purchase Order) prior to fabrication.

2.4 PREPARATION

- A. Remove and dispose of any existing signs off-site. Check with Owner if the signs are to be salvaged or destroyed.
- B. A simulated flag test may be required to pinpoint the exact positioning prior to installing the free-standing sign. Contact Owner to confirm whether this will be required prior to installation.

2.4 FINISHES, GENERAL

- A. Signs are to be secured in a suitable crate prior to shipping.
- 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

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with Owner's and manufacturer's written instructions. Do not install signs until all surface finishes are satisfactorily complete.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Exterior Fascia Signs shall be **thru-bolted** as noted on Manufacturer's engineering drawings. If this is not possible due to building design characteristics, the sign shall be securely fastened with suitably sized and spaced hurricane bolts and anchors as recommended by the manufacturer.
 - 2. Light weight signs: Use non-removable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended by sign manufacturer.
- C. Free-standing sign posts are not to be a direct-bury installation. A foundation of suitable size as designed by the manufacturer or his engineer shall be installed, complete with rebar and above grade anchor bolts. The top of the concrete base shall be installed in a Sonotube form 6" above the grade level.
- D. All exterior illuminated signs shall be wired in combination with a mechanical timer and adjustable photocell. Locate the photocell on the North side of the building.
 - 1. During daylight hours, the photo cell will override the time clock and turn **all** of the signs off. Adjust the photocell to switch signs on when weather is cloudy and overcast.
 - 2. Set the timer to turn signs off at 11:00pm and turn signs on at 5:00am.

3.2 ADJUSTING AND CLEANING

- A. After installation, clean soiled sign surfaces with non-abrasive dishwashing liquid and water per manufacturer's instructions. Protect signs from damage until acceptance by Owner.
- B. Remove debris created by sign installation, including bolts, screws, excavated debris, caulking tubes, etc.
- C. Repair disturbed areas in grass and drive areas to previous condition.
- D. Remove Sonotube foundation form and parge concrete if necessary.
- E. Evaluate signs at night for proper illumination.
 - 1. Eliminate any hot spots by adjusting light fixture positions.
 - 2. Correct any areas where light emits through faces and/or cabinets.
 - 3. Determine proper function of photocell and timer. Adjust as needed.
- F. Protect signs from damage until acceptance by Owner.

SECTION 10440 – NON-ILLUMINATED PANEL SIGNS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Non-illuminated panel signs shall be furnished by Owner and installed by the Contractor.
- B. This Section includes the following:
 - 1. Panel signs.
- C. Related Sections include the following:
 - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
 - 3. Division 26 Sections for electrical service and connections for illuminated signs.
 - 4. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
 - 5. Division 26 Section "Interior Lighting" for illuminated Exit signs.

1.2 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.3 SUBMITTALS

- A. Product Data: Furnished by Owner's vendor for each type of product Indicated.
- B. Shop Drawings: Provided by Owner's vendor. Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 PRODUCTS**2.0 MATERIALS**

- A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

2.1 PANEL SIGNS

- A. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
 - 1. Acrylic Sheet: 0.080 inch thick.
 - 2. Laminated Sheet: High-pressure engraved stock with face laminated to acrylic core as selected by Owner from manufacturer's full range.
 - 3. Laminated, Etched Photopolymer: Raised graphics with Braille 1/32 inch above surface with contrasting colors as selected by Owner from manufacturer's full range and laminated to acrylic back.
 - 4. Edge Condition: Square cut.
 - 5. Corner Condition: Square.
 - 6. Mounting: Framed.
 - a. Wall mounted with concealed anchors.
 - b. Manufacturer's standard anchors for substrates encountered.
 - 7. Color: As selected by Owner from manufacturer's full range.
 - 8. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.
- C. Panel Sign Frames:
 - 1. Acrylic Plastic:
 - a. Color: As selected by Owner from manufacturer's full range.
 - b. Profile: Square.
 - c. Corner Condition: Square.
 - d. Mounting: Wall mounted with concealed anchors.
- D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
 - 1. Panel Material: Opaque acrylic sheet.
 - 2. Raised-Copy Thickness: Not less than 1/32 inch.
- E. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are UV and water resistant for three years for application intended.
 - 1. Color: As selected by Owner from manufacturer's full range.
- F. Panel Sign Schedule:
 - 1. Sign Type: Toilet Rooms
 - a. Sign Size: 8" x 8"
 - b. Background Finish/Color: As selected by Owner from manufacturer's full range
 - c. Panel Sign/Frame: Cast acrylic sheet
 - 1) Finish/Color: As selected by Owner from manufacturer's full range.
 - d. Text/Message: Fixed.
 - 1) Character Size: According to ADA requirements or of authorities having jurisdiction, which ever requirements are more stringent.
 - 2) Character Finish/Color: As selected by Owner from manufacturer's full range.
 - 3) Copy: Raised
 - 4) Text: According to ADA requirements or of authorities having jurisdiction, which ever requirements are more stringent.
 - 5) Character Style: Helvetica
 - 2. Sign Type: Room Identification
 - a. Sign Size: 3" x 6 "
 - b. Background Finish/Color: As selected by Owner from manufacturer's full range
 - c. Panel Sign/Frame: Cast acrylic sheet
 - 1) Finish/Color: As selected by Owner from manufacturer's full range.

- d. Text/Message: Fixed.
 - 1) Character Size: According to ADA requirements or of authorities having jurisdiction, which ever requirements are more stringent.
 - 2) Character Finish/Color: As selected by Owner from manufacturer's full range.
 - 3) Copy: Tactile and Braille
 - 4) Text: Room name.
 - 5) Character Style: Helvetica
- 3. Sign Type: Occupancy
 - a. Sign Size: 3" x 12"
 - b. Background Finish/Color: As selected by Owner from manufacturer's full range
 - c. Panel Sign/Frame: Cast acrylic sheet
 - 1) Finish/Color: As selected by Owner from manufacturer's full range.
 - d. Text/Message: Fixed.
 - 1) Character Size: According to ADA requirements or of authorities having jurisdiction, which ever requirements are more stringent.
 - 2) Character Finish/Color: As selected by Owner from manufacturer's full range.
 - 3) Copy: Tactile and Braille
 - 4) Text: Maximum occupancy load
 - 5) Character Style: Helvetica
- 4. Sign Type: Accessible Entrance
 - a. Sign Size: 4 ½" x 4 ½"
 - b. Background Finish/Color: As selected by Owner from manufacturer's full range
 - c. Panel Sign/Frame: Cast acrylic sheet
 - 1) Finish/Color: As selected by Owner from manufacturer's full range.
 - d. Text/Message: Fixed.
 - 1) Character Size: According to ADA requirements or of authorities having jurisdiction, which ever requirements are more stringent.
 - 2) Character Finish/Color: As selected by Owner from manufacturer's full range.
 - 3) Copy: Tactile and Braille
 - 4) Text: Maximum occupancy load
 - 5) Character Style: Helvetica

2.2 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.

2.4 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other

components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy, background, and frame colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for three years for application intended.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions. Do not install signs until all surface finishes are satisfactorily complete.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs:
 - a. Install directional signs on walls adjacent to latch side of door where applicable. Where not possible, such as double doors, install signs on nearest adjacent walls and locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
 - b. Install menu-boards as indicated on Owner's schematic and anchor securely at a minimum of 32" horizontally and 24" vertically. Anchors are to be concealed behind menu-board flange cover.
 - c. Warning signs shall be installed in locations directed by Owner's representative.
 - 3. Exterior Wall Signs, such as snap frames, shall be installed as directed by Owner's representative.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 2. Mechanical Fasteners: Use non-removable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended by sign manufacturer.

3.2 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

SECTION 10505 – METAL LOCKERS

PART 1 – GENERAL

1.0 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 00 of the Specifications apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Metal lockers.
 - 2. Provide blocking, fasteners and anchorage devices to install lockers provided under this section.
 - 3. Provide metal filler panels to fill between banks of lockers and adjacent construction.

1.2 QUALITY ASSURANCE

- A. Installers Qualifications: Lockers to be installed by an experienced installer.

PART 2 – PRODUCTS

2.0 MANUFACTURERS

- A. Lockers provided by Owner and installed by G.C.

PART 3- EXECUTION

3.0 INSTALLATION

- A. All lockers securely anchored to wall and base with approved fastenings. Fastenings applied shall be through suitable reinforcing plates.

3.1 ADJUSTING

- A. General Requirements: Upon completion of installation, inspect lockers and adjust for proper door and locking mechanism operation.

3.2 CLEANING

- A. General Requirements
 - 1. Clean interior and exposed exterior surfaces, removing debris, dust, dirt, and foreign substances on exposed surfaces.
 - 2. Touch up scratches and abrasions to match original finish.
 - 3. Polish stainless steel and non-ferrous metal surfaces
 - 4. Replace locker units that cannot be restored to factory-finished appearance.
 - 5. Use only materials and procedures recommended or furnished by locker manufacturer.

SECTION 10522 - FIRE EXTINGUISHERS**PART 1 GENERAL****1.0 WORK INCLUDED**

- A. Fire Extinguishers
- B. Accessories

1.1 RELATED WORK

- A. Section 06100 - Rough Carpentry: Roughed-in wall openings.
- B. Section 09250 - Gypsum Wallboard
- C. Section 09920 – Interior Paint

1.2 REFERENCES

- A. NFPA 10 - Portable Fire Extinguishers.

1.3 QUALITY ASSURANCE

- A. Conform to NFPA 10 requirements for extinguishers. The Owner shall be responsible for fire extinguishers to be maintained by a qualified, bonded fire extinguisher company or person on an annual basis. Each extinguisher shall have a tag or label securely attached indicating the date and person performing the maintenance.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01340.
- B. Include physical dimensions, operational features, color and finish, wall mounting brackets with mounted measurements, anchorage details, rough-in measurements, location, and details.
- C. Submit manufacturer's installation instructions under provisions of Section 01340.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install extinguishers when ambient temperatures may cause freezing.

PART 2 PRODUCTS**2.0 MANUFACTURERS**

- A. AMEREX
- B. J.L. Industries
- C. Larsen's Manufacturing Company
- D. Substitutions: Under provisions of Section 01600.

2.1 MATERIALS

- A. Upper Service Area: 4A-60BC – Minimum 2 required. Refer to drawings.
- B. Lower Service Area: 4A-60BC – Minimum 2 required. Refer to drawings.
- C. Finishes: Red enamel

PART 3 EXECUTION

3.0 INSPECTION

- A. Ensure suitable means of support prior to installation.
- B. Beginning of installation means acceptance of existing conditions.

3.1 INSTALLATION

- A. Secure brackets rigidly in place in accordance with manufacturer's instructions. Recess cabinets (if applicable) into walls. Install bottom of cabinets 42" above floor.

SECTION 10606 CHAIN LINK FENCING AND GATES**PART 1 GENERAL****1.1 SUMMARY**

- A. The extent of chain link fences and gates as shown on the drawings.
 - 1. Exterior Fencing.

1.2 REFERENCES

- A. ASTM A36 Standard Specification for Carbon Structural Steel
- B. ASTM A392 Standard Specification for Zinc-Coated Steel Chain-Link Fabric
- C. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-dip Galvanized Coatings
- D. ASTM A817 Standard Specification for Metallic-Coated Steel Wire for Chain Link Fence Fabric and Marcellled Tension Wire
- E. ASTM A824 Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link
- F. ASTM F552 Standard Terminology Relating to Chain Link Fencing
- G. ASTM F567 Standard Practice for Installation of Chain Link Fence
- H. ASTM F626 Standard Specification for Fence Fittings
- I. ASTM F900 Standard Specification for Industrial and Commercial Swing Gates
- J. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
- K. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- L. WLG2445 Chain Link Fence Manufacturers Institute, Chain Link Fence Wind Load Guide for the Selection of Line Posts and Line Post Spacing

1.3 QUALITY CRITERIA

- A. Provide chain link fences and gates as complete units controlled by a single source including necessary erection accessories, fittings and fastenings.
- B. Substitutions: Alternate chain link products may be acceptable by the Valvoline Construction Manager as equal if approved in writing ten days prior to bidding provided that the items submitted meet the specifications contained in this document.
- C. Single source: To ensure system integrity obtain the chain link system, framework, fabric, fittings, gates and accessories from a single source.

1.4 SUBMITTALS

- A. Product Data; Submit manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fasteners, and accessories.
- B. Shop Drawings: For fabrication, location and installation of Chain Link Fencing and Gate assemblies. Include plans, elevations, sections, details, and attachments to other work.

PART 2 PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Submit to compliance with requirements, provide products of one of the following for chain link fencing:
 - 1. Master Halco
3010 Lyndon B Johnson Fwy
Suite 800
Dallas, TX 75234
Phone: (800) 883-8384

2.2 CHAIN LINK FENCING

A. Fabric:

1. Galvanized wire with fused vinyl coating: No. 9 ga., class 2 galvanized, ASTM A 392 (2 oz. zinc per sq. ft.), core size steel wires, 2" mesh, with top selvages knuckled for fabric 60" high and under, and both top and bottom selvages twisted and barbed for fabric over 60" high.. Furnish one piece fabric widths for fencing up to 12 ft. high and two piece fabric widths for fencing up to 24 ft. high. Two piece widths shall be attached to central horizontal railing with fabric overlapping and wire tied at 15 " on center.

a. Color: Midnight Black

b. Coating: ting thickness, galvanized coating weight, and wire tensile strength conform to ASTM F668, Class 2b. Federal Specification RR-F-191/1E Type IV, and AASHTO M-181 Type IV, Class B, as shown in table 1.

Table 1 - Permafuse Polyolefin Coated Steel Wire Characteristics

Zinc Coated Core Wire Size			Permafuse Coated Wire Finished Wire Size			Permafuse Coated Wire Allowable Variance		Core Wire Zinc Coating Weight, min.		Polyolefin Coating Thickness		Breaking Strength, minimum		Tensile Strength, min	
Gage	Inch	mm	Gage	Inch	mm	Oz/ft ²	g/m ²	Inch	mm	Inch	mm	lbf	Newtons	ksi	MPa
6	0.192	4.88	5	±0.005	±0.13	0.40	122	0.006 to 0.010	0.15 to 0.25			2,170	9,650	75	515
9	0.148	3.76	8	±0.005	±0.13	0.30	92					1,290	5,740	75	515
10	0.135	3.43	9	±0.005	±0.13	0.30	92					1,290	5,740	90	620
11	0.120	3.05	10	±0.005	±0.13	0.30	92					850	3,780	75	515
12	0.105	2.67	11	±0.004	±0.10	0.30	76					650	2,890	75	515
14	0.080	2.03	13	±0.004	±0.10	0.25	76					380	1,690	75	515

Note: Core wire sizes less than 0.120" (3.05 mm) are not contained in Federal specification RR-F-191 or AASHTO M-181

B. Framework:

1. Galvanized steel with PVC coating: Steel pipe Type I: ASTM F1043 Group IA, ASTM F1083 standard weight schedule 40 hot-dip galvanized pipe having a zinc coating of 1.8 oz/ft² (550 g/m²) on the outside surface and 1.8 oz/ft² (550 g/m²) on the inside surface.
 - a. Regular Grade: Minimum steel yield strength of 30,000 psi (205 MPa)

2.3 HARDWARE AND ACCESSORIES

- A. Galvanized, ASTM A 153 with zinc weights per ASTM Table 1.

2.4 FRAMING AND ACCESSORIES

- A. Fence foundations, rails, end, corner, pull and line posts shall meet all applicable local wind conditions and codes.
- B. End, corner, pull and line posts: Refer to tables on Architectural drawings for sizes and spacing required for type and height of fence per local wind speed.
- C. Post foundations: Refer to drawings.
- D. Posts Tops: Weather tight closure cap, one for each post. Furnish caps with openings for top rail.

2.5 GATES

- A. Fabricate swing gate perimeter frames from square tubes of size indicated on drawings. Metal and finish to match framework of fencing. Provide horizontals and attachment of fabric, hardware and accessories. Space so that frame members are not more than 8 foot apart. Tolerance between gate frame and opening shall not exceed 1/2" maximum.
- B. Assemble gate frames by welding or with special fittings and rivets for rigid connections. Use same fabric for standard gates as for fence unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 15" o.c. Attach hardware to provide security against removal or breakage. Install diagonal cross bracing in gate leafs 4' 0" and wider consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist.
- C. Standard Gate Hardware: Provide the following hardware and accessories for each gate:

1. Hinges: Size and material to suit gate size, non-liftoff type, offset to permit 180 degree opening.
 - a. Number of hinges required: Three (3) hinges on leafs up to 5'-0" in height, add one (1) additional hinge for each additional 2'-6" or fraction thereof.
2. Latch: Cane bolt per drawings.
- D. Double Gates: Provide manufacturer's stops for each leaf of double gates, consisting of a 2" I.D. x 6" long pipe sleeve cast into slab at both the closed and fully opened positions. Set in concrete to engage drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, using one padlock both gate leaves.

2.6 WIRE TIES

- A. For tying fabric to line posts, use 9 gage wire ties spaced 12" o.c. For tying fabric to rails and braces, use 9 gage wire ties spaced 24" o.c. For tying fabric to tension wire, use hog rings spaced 24" o.c.
- B. Manufacturer's standard procedure will be accepted if of equal strength and durability.
- C. For tying expanded metal mesh to chain link fencing use 9 gauge wire ties at 24" o.c. each way.

2.7 FENCE SLATS

- A. Product:
 1. Type: "M" Slat (HDPE) - 90% Privacy
 2. Wire Gauge: 9 gauge
 3. Mesh Size: 2"
 4. Height: Per drawings
 5. Color: Midnight Black

PART 3 EXECUTION

3.1 INSTALLATION

- A. Do not begin installation and erection before final grading is completed unless otherwise permitted.
- B. Excavation: Drill holes for posts in firm, undisturbed or compacted soil.
 1. Unless otherwise indicated, excavate hole depths approximately 6" lower than post bottom, with bottom of posts set not less than 48" below top of post foundation.
- C. Setting Posts: Center and align posts in holes 6" above bottom of excavation.
- D. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top align and hold in position during placement and finishing operation.
- E. Top Rails: Run rail continuously through post caps, bending radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer.
- F. Bottom Rails: Install in one (1) piece between posts and flush with post on fabric side using special offset fittings where necessary.
- G. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- H. Center Rails: Provide center rails where shown (5'-0" max.). Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.
- I. Gates: Install gates plumb, level and secure for full operation without interference. Install ground set items in concrete anchorage as recommended by fence manufacturer. Adjust hardware for smooth operation and lubricate where necessary.
- J. Tie Wires: Use U shaped wire, conforming to diameter of pipe to which attached, clasp pipe and fabric firmly with ends twisted at least two (2) full turns. Bend wire to minimize hazard to people or clothing.
- K. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or threads to prevent removal of nuts.
- L. Privacy slats: Install and lock in privacy slats in the fabric in accordance with manufacturer's instructions.

SECTION 10810 - TOILET ACCESSORIES**PART 1- GENERAL****1.0 SECTION INCLUDES**

- A. Toilet and washroom accessories.

1.1 RELATED SECTIONS

- A. Section 06100: Placement of concealed wood blocking.

1.2 QUALITY ASSURANCE

- A. Conform to Americans with Disabilities Act for installing work.

1.3 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Grabbar Warranty: manufacturer's standard form in which manufacturer agrees to replace defects such as rust that fail in materials or workmanship within specified warranty period.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2- PRODUCTS**2.0 MATERIALS**

- A. The Contractor shall provide and install the following toilet accessories as manufactured by Bobrick at the locations and heights shown on the drawings and as required by local handicap codes. Bradley (Universal Manufacturing Co.) is an acceptable alternative manufacturer. Contact for Corporate Express is Michele Bartel @ 513-870-8606.
 - 1. Grab bars
 - 2. Coat hooks
 - 3. Paper holders
 - 4. Customer Restroom Soap dispenser
 - 5. Employee Restroom Soap dispenser
 - 6. Paper Towel Dispenser
 - 7. Mirror
 - 8. Mop Holder
- B. Sheet Steel: ANSI/ASTM A366.
- C. Stainless Steel Sheet: ASTM A167, Type 304.
- D. Adhesive: Contact type, waterproof.
- E. Fasteners, Screws, and Bolts: Hot-dipped galvanized steel, tamper-proof type.

2.1 UNDERLAVATORY GUARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Plumberex Specialty Products, Inc.
 - 2. TCI Products.

3. Truebro, Inc.
- B. Under-Lavatory Guard:
 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping, and allow service access without removing coverings.
 2. Material and Finish: Antimicrobial, molded-plastic, white.

2.2 FABRICATION

- A. Form surfaces flat without distortion. Weld and grind joints smooth.
- B. Shop assemble components and package with anchors and fittings.
- C. Back paint components to prevent electrolysis.
- D. Provide steel anchor plates, adapters, and anchor components for installation.

2.3 FINISHES

- A. Anchors: Galvanize to 1/25 oz./sq yd.
- B. Chrome/Nickel Plating: ASTM B456, Type SC 2; satin finish.
- C. Stainless Steel: No. 4 satin luster finish.
- D. Under lavatory guards: White

PART 3- EXECUTION

3.0 EXAMINATION AND PREPARATION

- A. Verify exact location of accessories for installation.
- B. Deliver inserts and rough-in frames to site. Provide templates and rough-in measurements as required.
- C. Provide 1 1/2" solid blocking in stud walls and 3/4" PPT solid blocking in furred spaced of masonry walls for attachment of toilet accessories.
- D. Contractor is advised that the toilet room hardware is a special item and must be ordered early since there may be a lengthy delivery time.

3.1 INSTALLATION

- A. Install fixtures, accessories and items in accordance with manufacturer's instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate blocking.
- C. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

SECTION 11132 – TIRE ROTATION LIFTS**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

DEFINITION

- A. Surface mount and recessed low-rise hydraulic and bladder type tire rotation lifts designed for light duty vehicles.

1.2 REFERENCES

- A. The installation of equipment shall comply with the standards referred to in ASME/ANSI MH 14.1 except where they conflict with requirements of these specifications.

1.3 RELATED WORK

- A. Cast-In-Place Concrete: Section 03300.
- B. Division 22 Plumbing
- C. Division 26 Electrical
- D. Section 07900 - Joint Sealants

1.4 SUBMITTALS

- A. Shop Drawings (if requested by Owner): Submit fabrication details and connections to structure for the lift equipment. Include the following:
 - 1. General layout of installation, showing reaction points with reactions.
- B. Product Data (if requested by Owner): Catalog sheets, specifications, and installation instructions.
- C. Contract Closeout Submittals:
 - 1. Full load test report.
 - 2. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative.

1.5 QUALITY ASSURANCE

- A. Installers shall be skilled with lift and hoist installations and have at least 5 years experience.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protection:
 - 1. Protect equipment and exposed finishes during transportation and erection against damage.
 - 2. Protect exposed equipment, power unit, hydraulic ram, control button, oil reservoir from all foreign material during course of construction.

1.7 WARRANTY

- A. The manufacturer shall warrant the structural components of the Tire Rotation Lift to be free from defects in material and workmanship under normal use for a period of two years from invoice date.

PART 2 PRODUCTS**2.0 TIRE ROTATION LIFT MANUFACTURERS**

- A. Acceptable Manufacturers:
 - 1. Norco Industries Inc. 800-347-2232

2.1 PRODUCT REQUIREMENTS

- A. Equipment Requirements – Norco 79342G W/VIOC Accessories:
- B. Anchors:
 - 1. All necessary bearing plates and shims as required to adequately secure lift and ramps to pit floor including:
 - a. Thru-bolts
 - b. Double nuts with Grip-Tite application
 - c. 1/4" x 4" x 4" anchor plate on bottom-side
- C. Platform:
 - 1. Platform floor of 1/4 inch minimum steel plate with anti-slip ramp surface.
- D. Bearings: All pivot points and rollers shall be equipped with grease fittings and anti-friction bearings.
- E. Safety Devices:
 - 1. Means shall also be provided to lock the lift in place in raised position.
 - 2. The maximum load rating capacity shall be clearly noted on the power unit and lift assembly.
- F. Accessories:
 - 1. All necessary hoses and fittings required to connect power unit to lift, safety rated per manufacturer's requirements.
 - 2. Vehicle Stop Plates – Painted Safety Yellow.

2.2 RACEWAYS FOR HYDRAULIC FLEXIBLE HOSE INSTALLATION

- A. Rigid Nonmetallic Pipe, Fittings and Accessories: Carlon's Plus 40, Certain Teed Corp.'s Schedule 40, National Pipe & Co.'s Schedule 40, Queen City Plastics Inc.'s Schedule 40, or Sedco Pipe Products' Schedule 40.

PART 3 EXECUTION**EXAMINATION**

- A. Prior to installation, the contractor shall confirm with Owner that the floor is structurally suitable to handle the maximum load capacity. Owner shall arrange for any required structural remedies (if required) prior to installation.
- B. If the lift is a recessed unit, confirm that cut-out is correctly dimensioned and located. Advise Owner of any discrepancies.
- C. Coordinate location and installation of pipe raceway for installation of the hydraulic flexible hose from machine area to pit.
- D. If pre-cast floor, locate anchor position to avoid drilling into tendons.
- E. Determine location of lift control unit (if not indicated on drawings). Locate so as to allow operator to visually see the lift locking mechanism is engaged.
- F. There should be adequate space on all sides of the lift. Note that the lift and vehicle will move approximately 14" backward as the lift rises to its full height.
- G. Position lifts so that the front of vehicle in a raised position is not more than 4" beyond the covered floor area. For bladder controlled lifts, consider placement with understanding that the engine of the vehicle must be placed over the air bag portion of the lift.

3.1 GENERAL INSTALLATION

- A. Install leveler unit at location shown on the drawing. Mount bed plate frame to concrete slab.
- B. Install lift unit in accordance with the manufacturer's printed instructions.
- C. The bases must be aligned perfectly and the same distance apart.
- D. Shim as required to level both sides of the lift. Note: It is recommended that non-shrinking grout or some other solid material be placed under the lifts to ensure that no bending or warping takes place between shims.
- E. If installing above an open pit area, the unit must be thru-bolted. Consult manufacturer on anchoring requirements.
 - a. Utilize a method for drilling through the pre-cast or concrete floor that does not blow out the concrete.
 - b. Thru-bolts must be sealed along the top with Sika product Sikaflex 1-a Polyurethane black sealant to prevent moisture penetration.
- F. Place control pedestal in desired location and securely anchor to floor. Note: the unit must be positioned to allow full visibility by operator of the Safety Latchet Locking Mechanism. Seal around base of pedestal with Sika product Sikaflex 1-a Polyurethane black sealant to prevent moisture penetration.
- G. Air and electrical connections shall be in accordance with manufacturer and regulatory requirements.
- H. Lubricate grease fittings and all moving parts per manufacturer's instructions.
- I. Install safety decals provided with equipment.

3.2 TESTING AND ADJUSTMENT

- A. Tests: Supply all materials, personnel, instruments etc. required for testing of equipment.
 - 1. Perform a full load test ascertaining the lift makes smooth, level and accurate starts and stops.
 - 2. Ensure Safety Latchet Locking Mechanism engages and disengages properly.
 - 3. Ensure safety features (ie. pressure relief valves) operate properly.
 - 4. Ensure all hydraulic and air lines are tight.
 - 6. Bleed all air from hydraulic lines and ensure reservoir is filled.
 - 7. Test anchor penetrations to ensure moisture does not penetrate.
- B. Perform final tests in presence of Owner's Representative.

3.3 CLEANING

- A. Remove all debris resulting from the installation. Clean up all concrete dust resulting from drilling for anchors. Remove all dirt, smudges, fluids, etc. resulting from the installation.

SECTION 11146 – LUBRICATION EQUIPMENT**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. The lubrication system shall be furnished and installed by Owner hired contractor.
- B. This Section includes the following:
 - 1. Piping and accessories for the installation of lubrication system.
- C. Related Sections include the following:
 - 1. Division 22 Plumbing
 - 2. Division 11 Above-Ground Tanks

1.2 SUBMITTALS

- A. Product Data: Furnished by Owner's vendor for each type of product indicated.
- B. Shop Drawings: Provided by Owner's vendor. Show fabrication and installation details for each product and air supply.
 - 1. Indicate type pump
 - 2. Indicate the type metered gun for each product.
 - 3. Indicate various system components; valves, filters, hoses, etc.
 - 5. Provide equipment data sheets along with trouble-shooting guides and maintenance recommendations.
- C. Certification: Equipment meets UL and regulatory approval.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. U.L. 142, Underwriters Laboratories, Inc., Steel Aboveground Tanks for Flammable and Combustible Liquids.
 - 2. NFPA 30, National Fire Protection Association Flammable and Combustible Liquids Code.
 - 3. NFPA 30A, National Fire Protection Association Automotive and Marine Service Station Code.
 - 4. Uniform Fire Code, International Fire Code Institute.
 - 5. PEI/RP200- Petroleum Equipment Institute, Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling.
 - 6. An installer certified by the manufacturer.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. The General Contractor shall not arrange to install the Lubrication System until the facility is under roof and doors and windows are installed and can be locked.

1.5 WARRANTY

- A. Manufacturer's Conditional Warranty is five years on equipment from date of completed installation.

PART 2 PRODUCTS

2.0 MANUFACTURERS

- A. Alemite, LLC. Contact 800-233-0400
- B. Champion Compressed Air Piping. Contact Vince Eichhorn 405-473-1220 or Devon 800-468-1970

2.1 MATERIALS

- A. Product Lines: High Pressure fully annealed Seamless Steel Tubing.
 - 1. Steel Tubing is designated by its outside diameter (OD) and its wall thickness. While it is available in a wide range of sizes (3/8 in, 1/2 in, 5/8 in, 7/8 in, and 1 in OD) tubes are quite commonly used as fluid lines. Choice of wall thickness is practically unlimited and is governed by the working pressures encountered. Wall Thickness of Tubing .025 in .028 in .032 in .035 in .042 in .049 in .058 in .065 in .072 in .083 in .095 in .109 in .125 in
- B. The chart below lists general tubing selection guidelines for specified pumps. Each application varies and should be carefully considered for special conditions that may require a tubing selection other than the standard recommendations listed. These conditions include, but are not limited to:
 - 1. Viscosity of product pumped
 - 2. Ambient temperature conditions
 - 3. Simultaneous operation of several dispensing outlets
 - 4. Dispensing volume requirements
 - 5. When measuring total piping distance, the hose length at dispensing guns should be included in total distance.

a.	HIGH PRESSURE GREASE PUMP: PIPING RUNS 0 – 75'		
	Pump Ratio	Tubing Pipe OD.	Tubing Wall Size
	50:1	5/8"	.083"
b.	HIGH PRESSURE GREASE PUMP: PIPING RUNS 75' – 150'		
	Pump Ratio	Tubing Pipe OD.	Tubing Wall Size
	50:1	3/4"	.095"
c.	HIGH PRESSURE GREASE PUMP: PIPING RUNS - OVER 150'		
	Pump Ratio	Tubing Pipe OD.	Tubing Wall Size
	50:1	1"	.125"
d.	MEDIUM PRESSURE OIL PUMP: PIPING RUNS 0 – 200'		
	Pump Ratio	Tubing Pipe OD.	Tubing Wall Size
	3:1	5/8"	.035"
e.	MEDIUM PRESSURE OIL PUMP: PIPING RUNS - OVER 200'		
	Pump Ratio	Tubing Pipe OD.	Tubing Wall Size
	3:1	1"	.049"
f.	MEDIUM PRESSURE OIL PUMP: PIPING RUNS 0 – 200'		
	Pump Ratio	Tubing Pipe OD.	Tubing Wall Size
	5:1	5/8"	.035"
g.	MEDIUM PRESSURE OIL PUMP: PIPING RUNS - OVER 200'		
	Pump Ratio	Tubing Pipe OD.	Tubing Wall Size
	5:1	1"	.049"
- C. Air Lines – Aluminum Piping Color Blue
 - 1. Main Distribution Branch Line – 3/4"
 - 2. Branch Lines – 3/4"
- D. Evacuation Line
 - 1. 1" Black steel pipe
- E. Hose
 - 1. Oil Delivery Hose: 1/2" ID x 15'. 1/2" MxF

2. Oil Connecting Hose: 1/2" ID x 5'. 1/2" MxF
 3. Chassis Connecting Hose: 1/4" ID x 5'. 3/8" MBE
 4. Grease Supply Hose: 1/4" ID X 20'. 1/2" – 27 NS(F)
- F. All piping furnished and installed by installer.

2.2 ACCESSORIES

- A. Pumps
- B. Control Valves
- C. Tanks
- D. Air Compressor
- E. Fluid Gauges
- F. Filters
- G. Moisture Separators
- H. Drip Pans
- I. Valve Console
- J. Mounting Brackets
- K. Regulator
- L. Camlock Coupler
- M. Strainers
- N. Bibbs
- O. Holster
- P. Hose guide
- Q. Valves
- R. Miscellaneous pipe fittings
- S. Dryer (Model number CGD25A)

PART 3 **EXECUTION**

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. General
 1. Always use new pipe. Make certain that pipes are clean and free of rust and scale.
 2. When cutting pipe remove burrs and chips that may damage dispense valves and meters.
 3. Do not use Teflon Tape or pipe sealant on fluid and equipment threads.
 4. Install oil product pumps on topside of tanks unless there are overhead space limitations.
 5. Do not use dissimilar metal materials when anchoring piping.
 6. Minimize the number of Elbows which can reduce pressure drop. Use radius bends in preference to Elbows where installation permits.
 7. Install all piping neatly and in the same plane.
 8. Do not bore holes in pre-cast flooring without Owner and Owner's General Contractor approval.
 9. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
 10. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

11. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 12. Install equipment to allow right of way for piping installed at required slope.
 13. Mount pumps, tubing, etc. in a manner that limits movement during use.
 14. Fluid and air connections to pumps and reels must be made with a flexible hose, 18" minimum.
 14. Coordinate locations with all other trades before installing.
 15. Drawing plans, schematics, and diagrams indicate general location and arrangement of equipment and 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 necessitate a required change.
- B. Air
1. Install Owner furnished air compressor complete with S&S Un-loader, low oil level switch, 3/4" Ball Valve, four (4) vibration mounts, muffler, 1/4" drain valve, mag starter and pressure gauge.
 2. A 3/4" supply line shall be installed in a loop system with 1/2" air supply feeds to each pump provided positioned above the main distribution line and never in series. An 8" long moisture drop w/ ball valve for blow-off of moisture build-up shall be provided at each supply.
 3. The air distribution line shall slope continuously in direction of air flow.
- C. Product
1. When thermal expansion of oil may be present, use a pump pressure relief valve.
 2. Regulate air supply pressure to each pump as required to properly operate in accordance with manufacturer's requirements.
 3. Prior to attaching dispensing control valves, flush oil and grease lines with a cleaning solution followed by compressed air. Once this is complete, flush the system with oil before attaching control valves and meters.
 4. Remove and clean strainer screens and filters.

3.2 TESTING

- A. Aboveground storage tanks for flammable and combustible liquids are pre-tested by the manufacturer in accordance with the requirements of the underwriter's laboratories standard UL 142.
1. The Owner's installer shall successfully complete an air pressure test of 3-5 psi prior to installation of the piping system in accordance with manufacturer's recommendations but not less than 2 hours.
 - a. Utilize a soap solution and brush over weld seams and all tank bungs. Inspect tank contents before filling and replace tin caps with pipe plugs or doped piping before test.
 - b. When testing a double wall tank, the inner tank should be pressurized to a maximum capacity of the outer tank by bringing the pressure up very slowly to 3-5 p.s.i. Maximum capacity of the outer tank is very small in relation to the primary tank capacity. Compressors used for testing can over pressurize the outer tank space in seconds causing serious damage to the tank.
- B. Product, air and water lines shall be air tested at intended operating pressure for a period of 2 hours. **DO NOT** subject tanks to this pressure. Risk of rupture is probable.
- C. Owner's representative shall be contacted by the installer prior to the tests to arrange for test inspections.
- D. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
- E. Some equipment is capable of producing high pressure. Misuse or misapplication of this equipment can cause component rupture, fire or explosion and result in serious bodily injury, including fluid injection or splashing in the eyes or on the skin. **Never** exceed the

- maximum working pressure of the lowest-rated component in the system. See the instruction manual included with the equipment for more detailed information.
- F. Conduct metered tests of each product in accordance with manufacturer's recommendations, regulatory requirements and PEI-RP200.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled tank, piping and equipment surfaces according to manufacturer's instructions. Protect tanks and Lubrication System from damage until acceptance by Owner.

SECTION 11147 – ABOVE-GROUND TANKS**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Above ground tanks shall be furnished by Owner and installed by the Contractor.
- B. This Section includes the following:
 - 1. Single Wall Above-Ground Tanks
 - 2. Double Wall Above-Ground Tanks
- C. Related Sections include the following:
 - 1. Division 22 Plumbing
 - 2. Division 11 Section Lubrication Equipment
 - 3. Division 9 Painting.

1.2 SUBMITTALS

- A. Product Data: Furnished by Owner's vendor for each type of product indicated.
- B. Shop Drawings: Provided by Owner's vendor. Show fabrication and installation details for each size tank.
 - 1. Indicate bung size and location.
 - 2. Indicate lifting lug
 - 3. For double walled tanks, indicate cross section.
 - 4. For compartmentalized tanks, indicate cross section.
 - 5. Provide tank charts for each tank.
- C. Drawing Approval: Contractor shall receive drawing approval prior to product fabrication.
- D. Catalog Data: Contractor shall submit 1 current copy of the manufacturer's literature.
- E. Certification: Each tank shall bear the U.L. 142 label for aboveground liquid storage.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. U.L. 142, Underwriters Laboratories, Inc., Steel Aboveground Tanks for Flammable and Combustible Liquids.
 - 2. NFPA 30, National Fire Protection Association Flammable and Combustible Liquids Code.
 - 3. NFPA 30A, National Fire Protection Association Automotive and Marine Service Station Code.
 - 4. Uniform Fire Code, International Fire Code Institute.
 - 5. PEI/RP200- Petroleum Equipment Institute, Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings. The General Contractor shall arrange to install the tanks in the pit following the placement of the basement floor preferably at the time Pre-cast planks are set in place.

PART 2 PRODUCTS**2.0 MANUFACTURERS**

- A. Modern Welding Company of Kentucky, Inc. located in Elizabethtown, KY.: (270) 769-1368. Subsidiaries include:
 - 1. Modern Welding Company of Owensboro, Inc.
Owensboro, KY (270) 683-5323
 - 2. Modern Welding Company of Ohio, Inc.
Newark, OH (740) 344-9425
 - 3. Modern Welding Company of Florida, Inc.
Orlando FL (407) 843-1270
 - 4. Modern Welding Company of Texas, Inc.
Houston, TX (713) 675-4211
 - 5. Modern Welding Company of Texas, Inc.
Rhome, TX (817) 636-2215
 - 6. Modern Welding Company of Iowa, Inc.
Burlington, IA (319) 754-6577
 - 7. Modern Welding Company of California, Inc.
Fresno, CA (559) 275-9353
 - 8. Modern Welding Company of Georgia, Inc.
Augusta, GA (706) 722-3411
- B. Highland Tank: Stoystown, PA; Manheim, PA; Watervliet, NY; or Greensboro, NC.

2.1 MATERIALS

- A. Steel:
 - 1. Only new material shall be used in the manufacturing process, and the manufacturer shall ensure that the material used meets all appropriate specifications and quality assurance requirements. 1,000 gallon: Single and Double Walled Tanks shall be of all welded construction, fabricated of 10 gauge mild carbon steel.
 - 2. 500 gallon Single and Double Walled Tanks shall be of all welded construction, fabricated of 12 gauge thick mild carbon steel.
- B. Loading Conditions: Tanks shall meet the following design criteria.
 - 1. Internal Load: Tank(s) shall withstand an air pressure test of 3-5 psi.
 - 2. Tank(s) shall be designed to support accessory equipment such as ladders, pumps, floating suction, etc. when installed according to manufacturer's instructions.
 - 3. Tank(s) shall be provided with suitably designed and located lifting lugs which have a 2:1 safety factor.
- C. Product Storage Requirements
 - 1. Single Wall Tank(s) shall be capable of storing liquids with a specific gravity up to 1.0.
 - 2. Double wall tanks shall be capable of storing liquids with a specific gravity up to 1.1.
 - 3. Tank(s) is designed for operation at atmospheric pressure only. Tank(s) shall have openings of sufficient size to meet normal and emergency venting requirements stated in U.L. 142, UFC, and NFPA 30.
- D. Tank(s) shall be capable of storing gasoline, gasohol, jet fuel, avgas, diesel fuel or methanol at ambient temperature or used for fuel oil at temperatures not to exceed 120 degrees Fahrenheit.
- E. Tank shall conform to and be labeled in accordance with Underwriters Laboratories Standard UL-142 type S for single-wall and double-wall tanks.

2.02 ACCESSORIES

- A. Certification Plate: Underwriters Laboratories label shall be affixed to each tank.
- B. Fittings: Threaded/NPT
 - 1. All threaded fittings shall be of a material of construction consistent with the requirements of the Underwriters Laboratories label. All fittings shall be protected using threaded plugs or suitable closure caps.
 - 2. Location: Refer to drawings.
- C. Supports:

1. Design and quantity of the steel supports shall be such as to safely support the weight of the tank filled to capacity.
 - a. Height of supports: 2".

2.3 FABRICATION

- A. Standard construction shall utilize lap joints with continuous fillet weld on all outside seams only.
- B. Tank shall include five 2" forged steel fittings and one 4" or 6" forged steel emergency vent fitting for each tank wall. Two 2" forged fittings shall also be provided; at the bottom of each corner on one side of the tank.
- C. Fabrication shall include 2" high supports welded to the tank underside, providing ground clearance for visual inspection.
- D. Dimensional Requirements
 1. Single Wall Tanks:
 - a. 500 gallon: 5'0" long x 2'8" wide x 5'0" high
 - b. 1,000 gallon: 10'0" long x 2'8" wide x 5'0" high
 2. Double Wall Tanks:
 - a. 500 gallon: 5'1-1/2" long a 2'8-1/2" wide x 5'1/2" tall
 - b. 1000 gallon: 10'1-1/2" long a 2'8-1/2" wide x 5'1/2" tall
- E. Finish: Sherwin Williams Dura-Plate 235 self priming epoxy
 1. Color – Safety Red.
 2. Perform Holiday test to ensure no surface coating imperfections.

PART 3 **EXECUTION**

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Tank shall be installed in strict accordance with the most recent installation instructions provided by the tank manufacturer, PEI/RP200, UFC, NFPA 30, local ordinance, recognized engineering procedure, and other applicable codes.
- B. Handle tank carefully. Use cables, chains or lifting straps of adequate length (not more than 90 degrees between the chains) attached to lift lugs provided, oversize hooks will tear the lift lugs- use shackles, if necessary.
- C. Install appropriate primary and emergency vent connection as indicated on tank and drawings. The General Contractor is responsible for installation of all tank venting. Do Not manifold Waste Oil tank vent with Product Venting.
- D. Do not cut or weld on any tank that contains flammable or combustible liquids or vapors. Fire or explosion may result.
- E. Contact the local fire marshal to assure compliance with local regulations and codes.
- F. Be sure all drain plugs are secure by applying suitable pipe dope around cast iron plug.
- G. Ensure that tanks are level. Shim with galvanized steel shims as needed.

3.2 TESTING

- A. Aboveground storage tanks for flammable and combustible liquids are pre-tested by the manufacturer in accordance with the requirements of the underwriter's laboratories standard UL 142.

1. The Owner's installer shall successfully complete an air pressure test of 3-5 psi prior to installation of the piping system in accordance with manufacturer's recommendations.
2. Utilize a soap solution and brush over weld seams and all tank bungs. Inspect tank contents before filling and replace tin caps with pipe plugs or doped piping before test.
3. When testing a double wall tank, the inner tank should be pressurized to a maximum capacity of the outer tank by bringing the pressure up very slowly to 3-5 p.s.i. Maximum capacity of the outer tank is very small in relation to the primary tank capacity. Compressors used for testing can over pressurize the outer tank space in seconds causing serious damage to the tank.

3.2 CLEANING AND PROTECTION

- A. After installation, clean soiled tank surfaces according to manufacturer's instructions. Protect tanks from damage until acceptance by Owner.
- B. Do not walk on, stand on or use the tank surface as a working surface.
- C. The General Contractor shall cover tanks with polyethylene until such time that piping is installed.

SECTION 11303 – ABOVE- GROUND OIL/WATER SEPARATORS**PART 1: GENERAL****1.0 RELATED DOCUMENTS**

- A. The provisions of the General Conditions, Supplementary Conditions, Sections included under Division 1, General Requirements, and Division 00 of this Division are included as part of this Section as though bound herein. Refer to details and schedules on the drawings for additional requirements.

RELATED WORK**Division 22: Plumbing****SUMMARY**

- A. The Contractor shall furnish the labor, materials, and equipment in connection with the installation of pre-fabricated above-ground oil/water separator and lift sump. Work shall be as herein specified and as denoted on the accompanying Drawings but not limited to the following general terms of work:
 - 1. Sanitary sewer
 - 2. Manholes
 - 3. Oil/water separators
 - 4. Sump pump
- B. The oil/water separator shall be pre-packaged, pre-engineered, ready to install unit.

GOVERNING STANDARDS

- A. UL Subject 2215 Underwriters Laboratories Inc. Outline of Investigation for Oil/Water Separators
- B. National Fire Protection Association (NFPA 30) Flammable and Combustible Liquids Code, (NFPA 30A) Automotive and Marine Service Station Code, (NFPA 70) National Electric Code. Unified Facilities Guide Specification 13202A (July 2002) Division 13, Special Construction, Fuel Storage Systems.
- C. ASTM Specification D2996, Filament Wound Reinforced Thermosetting Resin in Pipe.
- D. EPA Test Method 1664A, Oil and Grease, Recoverable Extraction).

QUALITY ASSURANCE

- A. Test Data: The manufacturer must provide Certificate of Compliance from Underwriters Laboratories proving that the oil/water separator is capable of producing effluent with no more than 15 ppm free oil and grease (not dissolved nor chemically emulsified with soaps or detergents) when tested using the EPA Test Method 1664A. The test inlet oils are a 50/50 mixture per the UL Subject 2215 guidelines. The testing and results will show results for: Test per the UL SU2215 guidelines. The oil/water effluent cannot exceed average of 15 ppm.
- B. Oil/water separator is a fabricated steel unit constructed to meet governing standards with certification plate (UL Label) affixed.
- C. Shop Drawings: Contractor shall submit 4 copies of shop drawings. Drawings shall include all critical dimensions, locations of fittings, accessories, and installation instructions.
- D. All OWS tanks, equipment and piping materials shall be physically inspected and tested before being installed. Any defects observed shall be immediately brought to the attention of the Owner. It shall be the sole responsibility of the Contractor to correct any deficiencies, with the manufacturer in strict accordance with manufacturer's recommendations, at no additional cost to the Owner.
- G. Oil/water separators specified herein will not remove oils with specific gravities greater than 0.95, chemical or physical emulsions, dissolved hydrocarbons, or volatile organic compounds (VOC).

- H. The Contractor shall obtain and pay for all permits, tests, inspections, etc. required by the local boards that have jurisdiction over the project. All work shall be executed and inspected in accordance with all local and state codes, rules, ordinances, or regulations pertaining to the particular work involved. Should any changes in the contract drawings and specifications be required to conform to such ordinances, notify the Owner at time of submitting of bid. After entering into the contract, the Contractor shall be held responsible for the completion of all work necessary for a complete and approved installation without extra expense to the Owner.
- I. The OWS shall be a special purpose factory fabricated unit which is a standard product of a manufacturer regularly engaged in the production of such equipment with similar units operating for a minimum of five years.

WARRANTY

- A. Manufacturer shall provide a 30 year warranty on performance of the Oil / Water Separator.

PART 2: PRODUCTS

2.0 ACCEPTABLE MANUFACTURERS

- A. Zurn or approved equal.
 - 1. Manufacturer approved equals must be submitted to Owner for approval at least 3 days prior to bid due date.

2.1 OIL/WATER SEPARATOR TANKS:

- A. Provide Zurn Z-1186 size 700 prefabricated oil/water separator with draw-off provisions and miscellaneous fittings and accessories located as denoted on the Drawings.
Manufacturers: Subject to compliance with requirements, provide products per construction documents. Refer to Plumbing plans
- B. Tank must be vented.
- C. Tank shall be capable of storing liquids with specific gravity of up to 1.0.
- D. Tank shall be capable of storing grease and oils at temperatures not to exceed 100 degrees Fahrenheit at the internal tank surface.
- F. Tanks shall be chemically inert to petroleum products.
- G. Threaded fittings on UL labeled tanks shall be of a material of construction consistent with the requirements of the UL label. Fittings to be supplied with thread protectors. See contract drawings for size and locations of fittings.
- H. Threaded fittings on UL labeled tanks shall have nylon bushings installed for isolation purposes, unless specified piping is PVC or FRP.
- I. Separator shall be equipped with draw-off for waste oil removal.
- J. Separator shall be installed with a Z1108 flow control and a Z1090 backwater valve.

2.2 CAPABILITY AND DIMENSIONAL REQUIREMENTS

- A. The following information is dependent on the system design and shall be provided by the Owner prior to project bid:
 - 1. Oil/water separator shall be as indicated on drawings.
 - 2. Flow rate shall be from zero (0) to 20 gallons per minute.
 - 3. Nominal volume of the separator tank shall be 10 gallons.
 - 4. Inlet free oil specific gravity shall range from 0.70 to 0.95.
 - 5. Inlet free oil concentration shall be no more than 200,000 parts per million.
 - 6. Effluent free oil shall be no greater than 15 parts per million.
 - 7. Inlet flange diameter shall be 3 inches.
 - 8. Outlet flange diameter shall be 3 inches.
 - 9. Nominal overall length of the tank shall be 27".

10. Nominal outside width of the separator shall be 16-3/4".
11. Operating temperatures of the influent oil/water mixture shall range from 40 degrees Fahrenheit to 120 degrees Fahrenheit.
12. Bolt down lid shall be provided.
13. Location – See standard tank drawings

2.3 OIL/WATER INTERFACE FLOAT SENSOR (if applicable):

- A. Provide an Oil/Water Interface Alarm Sensor(s) that is used to determine two separate high waste oil levels in the separator. Level one is to activate at 20% oil and activates a visual alarm. Level two is to activate at 40% oil and activates a visual and audible alarm.
- B. The oil/water interface sensor shall be furnished by the oil/water separator manufacturer.
- C. The Contractor is responsible for finalizing the height of the riser pipe and for contacting the oil/water separator manufacturer with the details so the proper length model can be provided.
- D. First Oil Level Warning Alarm: This alarm warns that the oil/water separator tank is at a high level and the oil will need to be removed soon.
- E. Second Oil Level Warning Alarm: This alarm warns that the oil/water separator tank is at a dangerously high level and the oil will need to be removed immediately.

VENT PIPING

- A. Provide vent materials according to the schedule below. Contractor to use 2-inch FRP or PVC single wall piping.
- B. Vent Cap: 2-inch sch. 40 PVC with turn down elbow at top.
- C. All vents must be separate. Do not manifold with other vent piping.

PIPE MATERIALS:

- A. Provide the following materials as specified on the drawings.
- B. Ductile iron pipe, designated DIP on the drawings, shall be centrifugally cast push on joint ductile iron pipe conforming to ANSI Specification A21.51 with rubber gaskets conforming to ANSI Specification A21.11. Fittings shall be ductile iron conforming to ANSI Specification A21.10.
- C. Polyvinyl chloride pipe and fittings, designated SCH 40 PVC on the drawings, shall conform to ASTM D3034.

2.6 LIFT SUMP

- A. In some cases a lift sump may be installed inside the pit area of the building and piped to the OWS in accordance with drawings.
- B. The lift sump will be equipped with a sump pump and Constant Pressure Switch provided and installed by the General Contractor as follows:
 1. Sump Pump – Zoeller Model N-153 115volt single phase w/ 1-1/2" discharge, 1/2hp vortex impeller capable of handling 3/4" spherical solids (see attached cut sheet). Utilize Zoeller Model 30-0164, 1-1/2" cast iron check valve. In areas where an explosion proof sump pump is required by regulating authorities, the contractor shall utilize a Zoeller NX282 115volt single phase w/ 2" discharge 1/2hp vortex impeller capable of handling 2" spherical solids. Utilize Zoeller Model 30-0152, 2" cast iron check valve.
 2. Constant Pressure Switch (CPS). A constant pressure switch shall be installed at the discharge side of the OWS chamber. This is designed as means to contain spills and overfills from being discharged directly into the sanitary sewer. The General Contractor shall furnish and install an Allen Bradley model #800T-A601 momentary contact push-button switch in a NEMA Type 4 enclosure Allen Bradley #700T-ITZ. Verify connection requirements. Note: Sump shall not run unless the push button is engaged.

PART 3: EXECUTION**3.0 INSTALLATION**

- A. The interceptor may be placed on the floor, partially recessed in the floor, recessed with top flush with the floor, or fully recessed below the floor, in order to accommodate piping and structural conditions. However, unless specified otherwise or conditions prevent, the OWS shall be placed on the floor.
- B. Solid waste material shall not be permitted to enter the OWS.
- C. Install sump pump in lift sump with a constant pressure switch (if applicable).
- D. Install high oil level alarm (if applicable).
- E. Fill OWS with water and check that system is operational.
- F. Install flow control device (Z1108), furnished with the OWS in accordance with manufacturer's recommendations. The OWS incorporates two features to maintain equilibrium:
 - 1) Vented flow control device, and
 - 2) Air relief by-pass.

NOTE: The flow control device must be properly vented to permit air to properly mix with the fluid entering the interceptor. Air facilitates separation and, more importantly, is necessary to maintain the proper pressure and thus the proper operating level within the separation chamber. For example, without a properly vented flow control device, little or no air would be drawn into the interceptor during use, causing the operating level to rise, pushing the grease residue toward the cover. If the grease layer reaches the air relief by-pass, grease could be pushed on into the outlet. If air enters an interceptor that does not utilize an air relief by-pass, the buildup in air pressure has nowhere to go and begins pushing the grease and water layers downward toward the bottom of the interceptor.. If pressure continues to build, grease would eventually be forced under the baffle plate and out of the unit. The presence of a vented flow control device and air relief by-pass is a key element in the efficient operation of a grease interceptor. If one or both of these items are not present, flow rate through the interceptor and operational performance can be severely compromised.

3.1 VENTING

- A. The Zurn Z1186-ST and Z1188-ST Series oil interceptor with integral storage tank is furnished with 1-1/2" IPS vent connections located on all sides of the unit to accommodate the installation of the vent piping. Three of the vent connections are located on the oil storage tank, and one vent connection is located on the interceptor body upstream of the double wall trap seal. It is important that the unit be vented using any one of the vent connections provided. This will allow any of the volatile gases rising from the intercepted substances to be carried from the interceptor and storage tank to the atmosphere.
- B. All Zurn oil interceptors are furnished with 1-1/2" IPS vent and drawoff connections on both the right and left hand sides of the interceptor with plugs in one side. If necessary, the vent and drawoff connections can be changed from one side to the other at the time of installation, by switching the plugs.
- C. The vent connections are located above the adjustable gravity oil draw-off standpipe in the intercepting chamber. Thus, the volatile gases rising from the intercepted substances are carried from the interceptor to the atmosphere.

3.2 ADJUSTABLE DRAW-OFF

- A. The oil interceptor is furnished with a 1-1/2" IPS adjustable oil draw-off assembly. This draw-off can be furnished on either the right or left hand side of the interceptor. The oil draw-off consists of an adjustable pipe combination on the inside of the intercepting chamber, and a pipe connection from the internal adjustable standpipe on the side of the oil interceptor body to connect to an oil drain line from the oil interceptor to an oil storage tank.

- B. The adjustable standpipe can be raised or lowered inside the interceptor chamber to the proper height for draining off the separated oils and similar light density substances that have separated and floated to the surface of the interceptor chamber.
- C. After the oils and other substances have been accumulated in the interceptor, they can be drained from the interceptor chamber by gravity flow through the internal standpipe. The standpipe is adjusted so that the opening is located at 1/8" above the top of the water flow level in the interceptor chamber.
- D. There is no need to manually skim or dip out the oil, since the oil will drain off by gravity flow through the adjustable draw-off standpipe after it has been properly adjusted and tightened.

3.3 SETTING ADJUSTABLE DRAW-OFF

- A. The Zurn oil interceptor with integral storage tank should be completely installed and all connections made, including the adjustable draw-off gate plate.
- B. Loosen all bolts securing the gate plate as well as those above the gate plate. Slide the gate plate up to its highest position and tighten in place.
- C. Clean water is then run through the oil interceptor at the flow the interceptor is rated for. This establishes the operating water level. The operating water level is marked on the inside of the intercepting chamber. The marking of the operating water level must be done while there is water flowing through the interceptor. If the mark is established at the static water level, excess amounts of water will pass over the draw-off gate plate when the flow rate through the interceptor increases to its rated capacity. In this case, the draw-off gate plate would become submerged.
- D. Loosen the bolts securing the gate plate and slide the gate plate down so that the top edge is 1/8" above the operating water level mark.
- E. Tighten bolts securing the gate plate at this level.
- F. After the oil interceptor is put in operation and oil and low density substances will accumulate at the surface to a depth of 2" to 2-1/2" before the adjustable draw-off will start.
- G. Draw-off setting should be checked. Check draw-off by taking samples while the oil interceptor is in operation.

3.4 OIL FLOAT SENSOR INSTALLATION (IF APPLICABLE)

- A. Remove the covers that are located over the storage tank portion of the interceptor.
- B. Identify the discharge method in which the oil draws off into the storage tank (either an adjustable pipe/tube assembly (i.e. Z1186-83) or an adjustable gate plate assembly (i.e. Z1186-ST))
- C. Measure and record the length (L) across and width (W) across the storage tank from interior wall to interior wall (inches).
- D. Measure the oil volume height (H) of the storage tank from the bottom interior base to the bottom of the oil discharge point in inches (See Figure 1 below)
 Note: For Draw-Off Plate Type, ensure that the plate is adjusted to its lowest possible position before measuring the oil volume height.
- E. Multiply (L) x (W) x (H) and divide by 231 to compute the minimum storage volume (gallons) of oil storage in the tank.
- F. Multiply the oil storage volume from Step 5 by 80%. Take this number, divide by 231, then divide by length (L), then divide by width (W). The resultant will be a new height value in inches (H1) where the oil volume is at 80% of its capacity. This is the height from the bottom interior of the storage tank to where the Float Sensor should be located.
- G. Locate the Sensor Enclosure Box inside of the storage tank and remove the treadplate cover. Measure the distance from the exterior bottom of the enclosure box to the interior bottom of the storage tank (H2) in inches.
- H. Solve H2 - H1 to obtain the overall length of the float sensor assembly. Subtract 1-5/16" from this resultant to obtain the Length of 1/2" Conduit (Lc) necessary to connect the Float Sensor to the Sensor Box.
- I. Cut a piece of 1/2" conduit to the length (Lc) determined in Step 8. Deburr both ends

- and clean with PVC cleaner.
- J. Remove the cover of the Sensor Box by unscrewing the four machine screws that hold it on. Dry fit the Float Sensor, the PVC Conduit, and the Sensor Box together and place the assembly into the Sensor Box Enclosure.
 - K. With the assembly together and installed in the Sensor Enclosure Box, re-measure the distance from the bottom interior of the storage tank to the Float Sensor (H1) to verify that the 1/2" Conduit is cut to proper length.
 - L. Once (H1) is verified as correct, disassemble all components to prepare for actual assembly. If (H1) measures different than the calculated value of Step 6, repeat Steps 9 thru 11 to re-cut conduit to proper length.
 - M. Apply PVC Cement to one side of the 1/2" Conduit and insert into the socket fitting of the Sensor Box. Allow a few seconds for the cement to set up.
 - N. Run the Float Sensor wires through the other end of the 1/2" Conduit and out through the top of the sensor box. Apply PVC Cement to the other side of the Conduit and insert into the socket fitting of the Float Sensor. Allow a few seconds for the cement to set up.
 - O. Apply a bead of Silicon Sealant to the underside of the Sensor Box. Insert the Sensor Box into the Sensor Enclosure Box and secure using four #8-32 x 1/2" steel or stainless steel machine screws.
 - P. Coil the sensor wire up and place inside of Sensor Box. Re-secure the cover to the sensor box.
 - Q. Place the Interceptor Operating Instructions and Wiring Diagram inside of the Sensor Enclosure Box and re-secure the tread plate cover.
 - R. Re-secure the Oil Interceptor covers.
 - S. Locate the Display Box (See Figure 7 below) that is provided with the sensor package and remove the cover of the Display Box by unloosening the four machine screws that secure it. Inside of the Display Box is an electronic component that looks like a dial with numbers on it. This component causes a delay between the time the Float Sensor rises and the time that the audible and visible alarms are activated in the Display Box. The dial is normally set to somewhere between 2 and 3 minutes. Turn the dial counterclockwise until the mark lines up with Zero. This will eliminate any delay between the float signal and the display box alarms.
 - T. Re-secure the cover to the Display Box.

3.5 TESTING

- A. The General Contractor shall perform a tightness test of the OWS and associated piping in accordance with manufacturer's recommendations and regulatory requirements.
- B. Sump pump and Constant Pressure Switch shall be tested for proper operation. Sump pump check valve shall be verified to be in operation.
- C. Oil Level Sensor (if applicable) shall be tested for proper function in accordance with manufacturer's recommendations.
- D. Oil Draw-off shall be tested for proper operation.
- E. Provide Owner with test results.

SECTION 22050 - COMMON WORK RESULTS FOR PLUMBING**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS**2.0 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.3 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated; Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.

- E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Epco Sales, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Epco Sales, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.

- b. Calpico, Inc.
- c. Metraflex Co.
- d. Pipeline Seal and Insulator, Inc.
- 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- 3. Pressure Plates: Carbon steel. Include two for each sealing element.
- 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.0 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

- 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 Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 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 above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.

- b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
- c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
- 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position the pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Refer to Division 07 Section "Penetration Fire-stopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.1 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846 Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.2 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Coordinate locations with all other trades before installing.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

SECTION 22052 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.0 RELATED DOCUMENTS

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

1.1 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Pipe positioning systems.
 - 10. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
 - 3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-58, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner) for the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.
 - 5. Pipe positioning systems.

- B. Shop Drawings (if requested by Owner): Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Fiberglass strut systems. Include Product Data for components.
 - 4. Pipe stands. Include Product Data for components.
 - 5. Equipment supports.
- C. Welding certificates (if requested by Owner).

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. B-Line Systems, Inc.; a division of Cooper Industries.
 - 3. Grinnell Corp.
 - 4. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
 - 1. Available Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Unistrut Corp.; Tyco International, Ltd.
- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.
 - 1. Available Manufacturers:
 - a. Plasti-Fab, Inc.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-4, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Power-Strut Div.; Tyco International, Ltd.
 - 3. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FIBERGLASS STRUT SYSTEMS

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-4, made of fiberglass channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. Pipe Shields, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.

2.8 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.9 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Available Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.10 EQUIPMENT SUPPORTS

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

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and packaged, dry, hydraulic-cement, non-shrink and non-metallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, non-corrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.0 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. 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 non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. 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 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. 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.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

- J. 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.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb 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 absorb 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 absorb 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.
- L. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
- P. All riser/vertical applications to follow MSS SP-58 guidelines.

3.1 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. 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.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- Q. Insulated Piping: Comply with the following:
 - 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 according to 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. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood inserts.
- 6. Insert Material: Length at least as long as protective shield.
- 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

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

3.4 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 1-1/4 inches.

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

SECTION 22053 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Brass ball valves.
 - 3. Bronze ball valves.
 - 4. Iron ball valves.
 - 5. Iron, single-flange butterfly valves.
 - 6. Iron, grooved-end butterfly valves.
 - 7. Bronze lift check valves.
 - 8. Bronze swing check valves.
 - 9. Iron swing check valves.
 - 10. Iron swing check valves with closure control.
 - 11. Iron, grooved-end swing check valves.
 - 12. Iron, center-guided check valves.
 - 13. Iron, plate-type check valves.
 - 14. Bronze gate valves.
 - 15. Iron gate valves.
 - 16. Bronze globe valves.
 - 17. Iron globe valves.
 - 18. Lubricated plug valves.
 - 19. Chainwheels.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of valve indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.0 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.1 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- D. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.2 BRASS BALL VALVES

- A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - 2. Description:

- a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.
- D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.

- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

2.3 BRONZE BALL VALVES

- A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Reduced.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

- D. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Jenkins Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.4 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Kitz Corporation.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

- B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.
- D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.
- E. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.

- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.
- F. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.6 IRON, GROOVED-END BUTTERFLY VALVES

- A. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tyco Fire Products LP; Grinnell Mechanical Products.
 - b. Victaulic Company.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.
- B. 300 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. NIBCO INC.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. NPS 8 and Smaller CWP Rating: 300 psig.
 - c. NPS 10 and Larger CWP Rating: 200 psig.
 - d. Body Material: Coated, ductile iron.
 - e. Stem: Two-piece stainless steel.
 - f. Disc: Coated, ductile iron.
 - g. Seal: EPDM.

2.7 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Lift Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.8 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.
- C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.9 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
- B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Composition.
 - g. Seat Ring: Bronze.
 - h. Disc Holder: Bronze.

- i. Disc: PTFE or TFE.
 - j. Gasket: Asbestos free.
- C. Class 250, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.10 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.
- B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and weight.

2.11 IRON, GROOVED-END SWING CHECK VALVES

- A. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire Products LP; Grinnell Mechanical Products.
 - c. Victaulic Company.

2. Description:
 - a. CWP Rating: 300 psig.
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring-operated, ductile iron or stainless steel.

2.12 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.
- B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.
- D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.

- d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: Bronze.
- F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: Bronze.
- H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.

- c. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM or NBR.
- J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM or NBR.
- K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM or NBR.
- L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM or NBR.
- M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: EPDM or NBR.

- N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM or NBR.
- O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: EPDM or NBR.
- P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM or NBR.

2.13 IRON, PLATE-TYPE CHECK VALVES

- A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Flomatic Corporation.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: Bronze.
- B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.

- b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - e. Seat: Bronze.
- C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: Bronze.
- D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - e. Seat: Bronze.
- E. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Wafer, spring-loaded plate.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM or NBR.
- F. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM or NBR.
- G. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.
- H. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig.
 - c. Body Design: Wafer, spring-loaded plate.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM or NBR.
- I. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM or NBR.
- J. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.

2.14 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.

- e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, RS Bronze Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, NRS Bronze Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- D. Class 150, RS Bronze Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.16 IRON GATE VALVES

- A. Class 125, NRS, Iron Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.

- b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- B. Class 125, OS&Y, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- C. Class 250, NRS, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- D. Class 250, OS&Y, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.16 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.17 IRON GLOBE VALVES

- A. Class 125, Iron Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
- B. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.18 LUBRICATED PLUG VALVES

- A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48 or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION**3.0 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, gate, or plug valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe or angle or ball valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 150, nonmetallic disc.
 3. Ball Valves: One piece, full port, brass or bronze with brass trim.
 4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
 5. Bronze Gate Valves: Class 150, RS.
 6. Bronze Globe Valves: Class 150, nonmetallic disc.
 7. Iron Ball Valves: Class 150.
 8. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 9. Iron, Grooved-End Butterfly Valves: 300 CWP.
 10. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
 11. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
 12. Iron, Grooved-End Swing Check Valves: 300 CWP.
 13. Iron, Center-Guided Check Valves: Class 150, compact-wafer, resilient seat.
 14. Iron, Plate-Type Check Valves: Class 150; dual plate; resilient seat.
 15. Iron Gate Valves: Class 250.
 16. Iron Globe Valves: Class 250.

3.5 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 150, nonmetallic disc.
 3. Ball Valves: Two piece, full port, brass or bronze with brass trim.
 4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
 5. Bronze Gate Valves: Class 150, RS.
 6. Bronze Globe Valves: Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron Ball Valves: Class 150.
 3. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
 4. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
 5. Iron, Grooved-End Swing Check Valves: 300 CWP.
 6. Iron Gate Valves: Class 250, OS&Y.
 7. Iron Globe Valves: Class 250.
 8. Lubricated Plug Valves: Class 250, regular gland, flanged.

SECTION 22054 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic snubbers.
 - 12. Restraining braces and cables.
 - 13. Steel and inertia, vibration isolation equipment bases.

1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Seismic restraints shall be designed and installed in accordance with local codes and shall be acceptable to the authority having jurisdiction.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner) for the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal (if requested by Owner): For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings (if requested by Owner): Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates (if requested by Owner).
- E. Qualification Data (if requested by Owner): For professional engineer and testing agency.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage pre-approval OPA number from OSHPD, pre-approved by ICC-ES, or pre-approved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 PRODUCTS

2.0 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.

3. Isolation Technology, Inc.
4. Vibration Mountings & Controls, Inc.
- D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel base-plates, and factory cut to sizes that match requirements of supported equipment.
 1. Resilient Material: Oil- and water-resistant neoprene, rubber or hermetically sealed compressed fiberglass.
- E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with base-plate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- F. Restrained Mounts: All-directional mountings with seismic restraint.
 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- G. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 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. Base-plates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to base-plate underside. Base-plates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- H. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled base-plate bonded to 1/4-inch thick, neoprene or rubber isolator pad attached to base-plate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- I. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

- J. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- K. Spring Hangers: 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. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- L. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 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. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.1 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - 1. Amber/Booth Company, Inc.

2. California Dynamics Corporation.
 3. Isolation Technology, Inc.
 4. Mason Industries.
- D. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- E. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
1. Amber/Booth Company, Inc.
 2. Hilti, Inc.
 3. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil and water resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.
- F. Channel Support System: MFMA-3, shop or field fabricated support assembly made of slotted steel channels with 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; and rated in tension, compression, and torsion forces.

- G. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- H. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- I. 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.
- J. 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.
- K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- 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 seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing 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 inches.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127 and NFPA 13.
 - 2. Space lateral supports a maximum of 20 feet o.c., and longitudinal supports a maximum of 40 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. 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.
- G. 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.
- H. Drilled-in 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 the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed 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 Anchors: 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 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. Schedule test with Owner before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Owner's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
 - 11. Test and adjust air-mounting system controls and safeties.
 - 12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust piping 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.
- C. Adjust active height of sprint isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

SECTION 22070 - PLUMBING INSULATION**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Calcium silicate.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Tapes.
 - 9. Securements.
 - 10. Corner angles.
- B. Related Sections include the following:
 - 1. Division 21 Fire Suppression
 - 2. Division 23 Section "HVAC Insulation."

1.2 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings (if requested by Owner):
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.
- C. Samples (if requested by Owner): For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sample Sizes:
 - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - d. Sheet Jacket Materials: 12 inches square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data (if requested by Owner): For qualified Installer.

- E. Material Test Reports (if requested by Owner): From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports (if requested by Owner).

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.0 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

- D. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Industrial Insulation Group; Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Owens Corning; All-Service Duct Wrap.
- H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. CertainTeed Corp.; Commercial Board.

- b. Johns Manville; 800 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.
- J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; 1000 Series Spin-Glas.
 - b. Owens Corning; High Temperature Industrial Board Insulations.
- K. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000(Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.1 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.2 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Products, Division of ITW; CP-97.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
 - c. Marathon Industries, Inc.; 290.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
- C. Cellular-Glass, Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - b. Marathon Industries, Inc.; 225.
 - c. Mon-Eco Industries, Inc.; 22-25.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 1. For indoor applications, use lagging adhesives that have a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 4. Service Temperature Range: Minus 50 to plus 180 deg F.
 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Marathon Industries, Inc.; 405.
 - b. Mon-Eco Industries, Inc.; 44-05.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

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 C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC bi-axially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Dow Chemical Company; Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 5. PVDC Jacket for Outdoor Applications: 6-mil thick, white PVDC bi-axially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Dow Chemical Company; Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Dow Chemical Company; Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Very Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Chemical Company; Saran 540 Vapor Retarder Tape.
 2. Width: 3 inches.
 3. Film Thickness: 6 mils.
 4. Adhesive Thickness: 1.5 mils.
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: 55 lbf/inch in width.

2.8 SECUREMENTS

- A. Bands:
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Base-plate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Base-plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Base-plate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Base-plate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Base-plate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Base-plate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.
 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.9 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.

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

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat-tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use de-mineralized 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 equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom 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 application and finishing.
- 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 at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 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.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Hand-holes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Division 07 Section "Penetration Fire-stopping" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Fire-stopping."

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.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric 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.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 CELLULAR-GLASS INSULATION INSTALLATION

- 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 factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed 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 pipe insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as 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 sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed 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 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed 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 mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Inspect field-insulated equipment by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 2. Inspect pipe, fittings, strainers, and valves by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Domestic water pump insulation shall be one of the following:

- D. Domestic water, domestic hot-water hydro-pneumatic tank insulation shall be one of the following:
 - 1. Cellular Glass: 1-1/2 inches thick.
 - 2. Flexible Elastomeric: 1 inch thick.
 - 3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
 - 4. Mineral-Fiber Pipe and Tank: 1 inch thick.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

SECTION 22111 - DOMESTIC WATER PIPING

PART 1- GENERAL

1.0 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Under-ground slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Encasement for piping.
 - 3. Specialty valves.
 - 4. Flexible connectors.
 - 5. Water meters furnished by utility company for installation by Contractor.
 - 6. Water meters.
 - 7. Escutcheons.
 - 8. Sleeves and sleeve seals.
 - 9. Wall penetration systems.
- B. Related Section:
 - 1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Water meters.
 - 6. Backflow preventers and vacuum breakers.
 - 7. Escutcheons.
 - 8. Sleeves and sleeve seals.
 - 9. Water penetration systems.
- B. Water Samples (if requested by Owner).
- C. Coordination Drawings (if requested by Owner): For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.

- 2. Domestic water piping.
- D. Field quality-control reports (if requested by Owner).

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.5 COORDINATION

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

PART 2- PRODUCTS

2.0 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.1 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. 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.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) NVent LLC.
 - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
 - 7. Copper-Tube Extruded-Tee Connections:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2144.
 - 8. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
 - 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.
- C. Plain-End, Ductile-Iron Pipe: AWWA C151.
 - 1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE, FITTINGS AND JOINING/FUSION

A. Resin and Material Requirements

1. All materials shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D 3350 with a minimum cell classification of 445474C. HDPE pipe and fittings shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. HDPE products shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; 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 B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet or Tube.
- C. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
- D. Color: Black or Natural.

2.6 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.7 TRANSITION FITTINGS

- 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 Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc.
 - d. JCM Industries.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - b. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Pipeline Seal and Insulator, Inc.
 - 2. Description:
 - a. Non-conducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.

- d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 - 2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and non-corrosive, thermoplastic.
- F. Dielectric Nipples:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
 - 2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and non-corrosive, propylene.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Flex-Hose Co., Inc.
 - 2. Hyspan Precision Products, Inc.
 - 3. Mercer Rubber Co.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
- 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
- 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.10 WATER METERS

- A. Displacement-Type Water Meters:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB.
 - b. Badger Meter, Inc.
 - c. Mueller Company; Water Products Division.
 - 2. Description:

- a. Standard: AWWA C700.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility.
 - e. Case: Bronze.
 - f. End Connections: Threaded.
- B. Turbine-Type Water Meters:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB.
 - b. Badger Meter, Inc.
 - c. Mueller Company; Water Products Division.
 - 2. Description:
 - a. Standard: AWWA C701.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Turbine; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company .
 - e. Case: Bronze.
 - f. End Connections for Meters NPS 2 and Smaller: Threaded.
 - g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.
- C. Compound-Type Water Meters:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB.
 - b. Badger Meter, Inc.
 - 2. Description:
 - a. Standard: AWWA C702.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: With integral mainline and bypass meters; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. Pipe Connections: Flanged.
- D. Fire-Service-Type Water Meters:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Badger Meter, Inc.
 - b. Mueller Company; Water Products Division.
 - 2. Description:
 - a. Standard: AWWA C703 and UL listing.
 - b. Pressure Rating: 175-psig working pressure.
 - c. Body Design:
 - 1) Turbine-Type Water Meters: With strainer, and with meter on bypass.
 - a) Strainer: Full size, matching water meter.
 - b) Bypass Meter: AWWA C701, turbine type with bronze case; not less than NPS 2.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. Pipe Connections for Meters NPS 2 and Smaller: Threaded.
 - g. Pipe Connections for Meters NPS 2-1/2 and Larger: Flanged.
- E. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

- F. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

2.11 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.12 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.13 SLEEVE SEALS

- 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. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.

- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Plastic.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.14 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, [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]:
 - 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 - 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 - 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 - 3. Housing-to-Sleeve Gasket: EPDM rubber.
 - 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 - 5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53, Schedule 40, zinc-coated steel pipe.

2.15 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3- EXECUTION

3.0 EARTHWORK

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

3.1 PIPING INSTALLATION

- 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 according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. 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.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping adjacent to equipment and specialties to allow service and maintenance.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install PEX piping with loop at each change of direction of more than 90 degrees.
- T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 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 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.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- J. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- K. Steel-Piping Grooved Joints: Cut or roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. PEX Piping Joints: Join according to ASTM F 1807.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2

and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install bronze-hose flexible connectors in copper domestic water tubing.
- B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 WATER METER INSTALLATION

- A. Rough-in domestic water piping for water meter installation according to utility company's requirements.
- B. Install water meters according to AWWA M6, utility company's requirements, and the following:
- C. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
- D. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities

having jurisdiction.

- E. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
- F. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
- G. Install remote registration system according to standards of utility company and of authorities having jurisdiction.
- H. Irrigation system shall be metered separately.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.

- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.

- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PVC.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Stack sleeve fittings.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Comply with requirements in Division 07 Section "Penetration Fire-stopping" for fire-stop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.14 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

- B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 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 for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.16 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and 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.

3.17 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 according to either of the following:
 - c. Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - d. Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - e. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - f. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
 1. Soft copper tube, ASTM B 88, Type K or ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.

- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K or ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
 - 2. Mechanical-joint, ductile-iron pipe; standard or compact pattern mechanical-joint fittings; and mechanical joints.
 - 3. Push-on-joint, ductile-iron pipe; standard or compact pattern push-on-joint fittings; and gasketed joints.
 - 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- F. Under-building slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard or compact pattern mechanical-joint fittings; and mechanical joints.
 - 2. Push-on-joint, ductile-iron pipe; standard or compact pattern push-on-joint fittings; and gasketed joints.
 - 3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard or soft copper tube, ASTM B 88, Type L; wrought copper solder-joint fittings; and brazed joints.
- H. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; cast or wrought copper solder-joint fittings; and soldered joints.
 - 3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 4. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper push-on-joint fittings; and push-on joints.
- I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint copper-tube appurtenances; and grooved joints.
- J. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; cast or wrought copper solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint copper-tube appurtenances; and grooved joints.
- K. Above ground, combined domestic-water-service and fire-service-main piping, NPS 6 to NPS 12, shall be the following:
 - 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

3.19 VALVE SCHEDULE

- A. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

SECTION 22131 - SANITARY WASTE AND VENT PIPING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

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

1.1 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps."
 - 2. Division 22 Section "Chemical Waste-Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
 - 2. Sanitary Sewer, Force-Main Piping: 150 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.4 SUBMITTALS

- A. Product Data (if requested by Owner): For pipe, tube, fittings, and couplings.
- B. Shop Drawings (if requested by Owner):
 - 1. Design Calculations (if requested by Owner): Signed and sealed by a qualified professional engineer for selecting seismic restraints.
- C. Field quality-control inspection and test reports (if requested by Owner).

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS**2.0 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class/es.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) Mission Rubber Co.
 - 2) Tyler Pipe; Soil Pipe Div.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Tyler Pipe; Soil Pipe Div.
 - 3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) MG Piping Products Co.
- C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. ANACO.

2.4 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint Systems:
 1. Available Manufacturers:
 - a. Victaulic Company.
 2. Grooved-End, Ductile-Iron Fittings: ASTM A 47, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.6 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- D. Solvent Cement and Adhesive Primer:
 1. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.
 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.
- D. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 SPECIAL PIPE FITTINGS

- A. Flexible, Non-pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 1. Available Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Co.
 - d. NDS, Inc.
 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Non-pressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
- C. Rigid, Unshielded, Non-pressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 1. Available Manufacturers:
 - a. ANACO.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. JCM Industries, Inc.
 - c. Romac Industries, Inc.
 - d. Smith-Blair, Inc.
 2. Center-Sleeve Material: Manufacturer's standard.
 3. Gasket Material: Natural or synthetic rubber.
 4. Metal Component Finish: Corrosion-resistant coating or material.
- E. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
- F. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.

- G. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Available Manufacturers:
 - a. SIGMA Corp.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, cross-laminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.
- B. Form Sheet or tube.
- C. Color: Black or natural.

PART 3 - EXECUTION

3.0 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.1 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel; and rigid, unshielded couplings; and hubless coupling joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 6. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and solvent stack fittings; standard, and heavy-duty shielded, stainless-steel couplings; and hubless coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 5. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard shielded, stainless-steel; and rigid, unshielded couplings; and hubless coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. Stainless-steel pipe and fittings gaskets, and gasketed joints.
 - 5. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 - 6. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 7. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 8. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and rigid, unshielded couplings; and hubless coupling joints.
 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
 4. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 5. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 7. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel; and heavy-duty shielded, cast-iron couplings; and hubless coupling joints.
 3. Solid-wall, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 4. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.
- J. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
1. Soft copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Steel pipe, pressure fittings, and threaded joints.
 - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
 3. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical joints.
 - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
 4. Push-on-joint, ductile-iron pipe; push-on-joint ductile-iron fittings; gaskets; and gasketed joints.
 - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
 5. Pressure pipe couplings, if dissimilar pipe materials or piping with small difference in OD must be joined.
- K. Underground sanitary-sewage force mains NPS 5 and larger shall be any of the following:

1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical-joint joints.
2. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron fittings; gaskets; and gasketed joints.
3. Pressure pipe couplings, if dissimilar pipe materials or piping with small difference in OD must be joined.

3.2 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install underground, steel, force-main piping.[Install encasement on piping according to ASTM A 674 or AWWA C105.]
- G. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- H. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- I. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- J. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- K. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- M. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- N. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- O. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- P. Install engineered soil and waste drainage and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- Q. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- R. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- S. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- T. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.
- U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- G. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
1. Horizontal Piping: Horizontal backwater valves.
 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.
 4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6: 60 inches with 3/4-inch rod.
 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 2: 84 inches with 3/8-inch rod.
 2. NPS 3: 96 inches with 1/2-inch rod.
 3. NPS 4: 108 inches with 1/2-inch rod.
 4. NPS 6: 10 feet with 5/8-inch rod.
- K. Install supports for vertical stainless-steel piping every 10 feet.
- L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.
- M. Install supports for vertical copper tubing every 10 feet.
- N. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 2. NPS 3: 48 inches with 1/2-inch rod.
 3. NPS 4 and 5: 48 inches with 5/8-inch rod.
 4. NPS 6: 48 inches with 3/4-inch rod.
 5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- O. Install supports for vertical ABS and PVC piping every 48 inches.

- P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

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 drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main or sanitary manhole.
 - 2. Sewage Pumps: To sewage pump discharge.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

SECTION 22132 - SANITARY WASTE PIPING SPECIALTIES**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Trench drains.
 - 5. Air-admittance valves.
 - 6. Roof flashing assemblies.
 - 7. Through-penetration firestop assemblies.
 - 8. Miscellaneous sanitary drainage piping specialties.
 - 9. Flashing materials.
 - 10. Grease interceptors.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Grease interceptors.
- B. Shop Drawings (if requested by Owner): Show fabrication and installation details for frost-resistant vent terminals.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification (if requested by Owner): Submit certification that grease interceptors, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification (if requested by Owner): Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit (if requested by Owner): Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports (if requested by Owner).
- E. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.0 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.14.1.
 3. Size: Same as connected piping.
 4. Body: Cast iron.
 5. Cover: Cast iron with bolted or threaded access check valve.
 6. End Connections: Hub and spigot or hubless.
 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Size: Same as floor drain outlet.
 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 4. Check Valve: Removable ball float.
 5. Inlet: Threaded.
 6. Outlet: Threaded or spigot.
- C. Horizontal, Plastic Backwater Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Zurn Plumbing Products Group; Light Commercial Operation.
2. Size: Same as connected piping.
3. Body: ABS.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 3. Size: Same as connected drainage piping
 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure: Countersunk brass plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 7. Closure: Stainless-steel plug with seal.
- B. Metal Floor Cleanouts:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group
 2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Threaded, adjustable housing.
 5. Body or Ferrule: Cast iron.
 6. Clamping Device: Required.
 7. Outlet Connection: Threaded.
 8. Closure: Brass plug with straight threads and gasket.
 9. Adjustable Housing Material: Plastic with threads.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 11. Frame and Cover Shape: Square.
 12. Top Loading Classification: Heavy Duty.
 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.

4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure: Countersunk, drilled-and-threaded plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
- D. Plastic Floor Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Size: Same as connected branch.
 3. Body: PVC.
 4. Closure Plug: PVC.
 5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group.
 2. Standard: ASME A112.6.3.
 3. Pattern: Floor drain.
 4. Body Material: Gray iron.
 5. Seepage Flange: Required.
 6. Clamping Device: Required.
 7. Outlet: Bottom.
 8. Backwater Valve: Not required.
 9. Coating on Interior and Exposed Exterior Surfaces: Not required.
 10. Sediment Bucket: Not required.
 11. Top or Strainer Material: Nickel bronze.
 12. Top of Body and Strainer Finish: Nickel bronze.
 13. Top Shape: Square.
 14. Dimensions of Top or Strainer: 6 inch Square.
 15. Top Loading Classification: Heavy Duty.
 16. Funnel: See Plans.
 17. Inlet Fitting: Not required.
 18. Trap Material: Not required.
 19. Trap Pattern: Not required.
 20. Trap Features: Not required.
- B. Plastic Floor Drains:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Standard: ASME A112.6.3.
 3. Material: ABS or PVC.
 4. Seepage Flange: Required.
 5. Clamping Device: Required.
 6. Outlet: Side.

7. Sediment Bucket: Not required.
8. Top or Strainer Material: Bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Square.
11. Dimensions of Top or Strainer: 6 inch Square.
12. Trap Material: Not required.
13. Trap Pattern: Not required.

2.3 TRENCH DRAINS

- A. Trench Drains:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.3 for trench drains.
 3. Material: Ductile or gray iron.
 4. Flange: Seepage.
 5. Clamping Device: Not required.
 6. Outlet: Bottom.
 7. Grate Material: Stainless steel.
 8. Grate Finish: Not required.
 9. Dimensions of Frame and Grate: See Drawings.
 10. Top Loading Classification: Extra Heavy-Duty.
 11. Trap Material: Not required.
 12. Trap Pattern: Not required.

2.4 AIR ADMITTANCE VALVES

- A. Stack Air-Admittance Valves:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Studor, Inc.
 3. Standard: ASSE 1050 for vent stacks.
 4. Housing: Plastic.
 5. Operation: Mechanical sealing diaphragm.
 6. Size: Same as connected stack vent or vent stack.
- B. Wall Box:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Studor, Inc.
 3. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
 4. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.5 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - 1. Open-Top Vent Cap: Without cap.
 - 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Fire-stop Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
 - 2. Standard: UL 1479 assembly of sleeve and stack fitting with fire-stopping plug.
 - 3. Size: Same as connected soil, waste, or vent stack.
 - 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 5. Stack Fitting: ASTM A 48, gray-iron, hubless pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 6. Special Coating: Corrosion resistant on interior of fittings.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 - 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 - 2. Size: Same as connected waste piping.
- B. Deep-Seal Traps:
 - 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 - 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. 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.

- E. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fitting of the riser or stack piping.
- F. Stack Flashing Fittings:
 - 1. Description: Counter-flashing-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.
- G. 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.
- H. Frost-Resistant Vent Terminals:
 - 1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
 - 2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counter-flashing.
- I. Expansion Joints:
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected soil, waste, or vent piping.

2.8 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft.
 - 2. Vent Pipe Flashing: 8 oz./sq. ft.
- C. Zinc-Coated Steel Sheet: ASTM A 653, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. 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.

- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- H. Install stack air-admittance valves at top of stack vent and vent stack piping.
- I. Install air-admittance-valve wall boxes recessed in wall.
- J. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- K. Assemble open drain fittings and install with top of hub 2 inches above floor.
- L. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- M. 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.
- N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- O. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- P. Install vent caps on each vent pipe passing through roof.
- Q. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- R. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- S. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- T. Install oil-water separator if required, including trapping, venting, and flow-control fitting, according to Owner's drawings, Division 11 of these specifications and manufacturer requirements.
 - 1. Install cleanout immediately downstream from oil-water separator not having integral cleanout on outlet.
- U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

- V. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.1 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Oil-Water Separators: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic draw-off type unit.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counter-flashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install Owner furnished plastic-laminate equipment nameplate or sign on or near each of the following if applicable:
 - 1. Oil-Water Separator.
 - 2. Oil-Water Lift Sump

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.

SECTION 22141 - FACILITY STORM DRAINAGE PIPING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sump Pumps."

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. TPE: Thermoplastic elastomer.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
 - 2. Storm Drainage, Force-Main Piping: 150 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.4 SUBMITTALS

- A. Product Data (if requested by Owner): For pipe, tube, fittings, and couplings.
- B. Shop Drawings (if requested by Owner):
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
 - 2. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.
- C. Field quality-control inspection and test reports (if requested by Owner).

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS**2.0 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class/es.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Tyler Pipe; Soil Pipe Div.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Tyler Pipe; Soil Pipe Div.
 - 3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) MG Piping Products Co.
- C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. ANACO.

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
- C. Pressure Fittings:
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.

4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.
- D. Grooved-Joint Systems:
 1. Available Manufacturers:
 - a. Anvil International.
 - b. Victaulic Co. of America.
 2. Grooved-End, Steel-Piping Fittings: ASTM A 47, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.5 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint Systems:
 1. Available Manufacturers:
 - a. Victaulic Co. of America.
 2. Grooved-End, Ductile-Iron Fittings: ASTM A 47, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.6 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.7 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

2.8 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
 - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.
 - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

2.9 SPECIAL PIPE FITTINGS

- A. Flexible, Non-pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. Fernco, Inc.
 - b. NDS, Inc.
 - 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Non-pressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
- C. Rigid, Unshielded, Non-pressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. ANACO.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. JCM Industries, Inc.
 - c. Romac Industries, Inc.
 - d. Viking Johnson.
 - 2. Center-Sleeve Material: Manufacturer's standard.
 - 3. Gasket Material: Natural or synthetic rubber.
 - 4. Metal Component Finish: Corrosion-resistant coating or material.
- E. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
 - 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
- F. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.
- G. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 1. Available Manufacturers:
 - a. SIGMA Corp.

2.10 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

PART 3 - EXECUTION

3.0 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.1 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard shielded, stainless-steel couplings; and coupled joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Copper DWV tube, copper drainage fittings, and soldered joints.
 5. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 6. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 7. Dissimilar Pipe-Material Couplings: Rigid, unshielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and coupled joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and coupled joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: Rigid, unshielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Flexible, Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.2 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
- E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- F. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- H. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- K. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- L. Install engineered controlled-flow storm drainage piping in locations indicated.
- M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- N. Install ABS storm drainage piping according to ASTM D 2661.
- O. Install PVC storm drainage piping according to ASTM D 2665.
- P. Install underground ABS and PVC storm drainage piping according to ASTM D 2321.
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Cut groove ends of pipe and assemble grooved ends of pipes, grooved-end fittings, and grooved-end-piping couplings according to AWWA C606.
- G. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves.
 - 2. Install backwater valves in accessible locations.
 - 3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 feet, if indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.

5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.
- K. Install supports for vertical copper tubing every 10 feet.
- L. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 2. NPS 3: 48 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 4. NPS 6: 48 inches with 3/4-inch rod.
 5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- M. Install supports for vertical ABS and PVC piping every 48 inches.
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

SECTION 22142 - STORM DRAINAGE PIPING SPECIALTIES**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Trench drains.
 - 4. Channel drainage systems.
 - 5. Catch basins.
 - 6. Through-penetration firestop assemblies.
 - 7. Roof drains.
 - 8. Miscellaneous storm drainage piping specialties.
 - 9. Flashing materials.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PUR: Polyurethane plastic.
- H. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.5 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS**2.0 BACKWATER VALVES**

- A. Horizontal, Cast-Iron Backwater Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - b. Tyler Pipe; Wade Div.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.14.1.
 3. Size: Same as connected piping.
 4. Body: Cast iron.
 5. Cover: Cast iron with bolted or threaded access check valve.
 6. End Connections: Hub and spigot or hubless.
 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Size: Same as floor drain outlet.
 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 4. Check Valve: Removable ball float.
 5. Inlet: Threaded.
 6. Outlet: Threaded or spigot.
- C. Horizontal, Plastic Backwater Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. IPS Corporation.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Size: Same as connected piping.
 3. Body: PVC.
 4. Cover: Same material as body with threaded access to check valve.
 5. Check Valve: Removable swing check.
 6. End Connections: Socket type.

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Tyler Pipe; Wade Div.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 3. Size: Same as connected drainage piping
 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure: Raised-head, cast-iron plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.
- B. Metal Floor Cleanouts:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Adjustable housing.
 5. Body or Ferrule: Cast iron.
 6. Clamping Device: Required.
 7. Outlet Connection: Threaded.
 8. Closure: Cast-iron plug.
 9. Adjustable Housing Material: Cast iron with threads.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 11. Frame and Cover Shape: Square.
 12. Top Loading Classification: Heavy Duty.
 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Tyler Pipe; Wade Div.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 4. Standard: ASME A112.36.2M. Include wall access.
 5. Size: Same as connected drainage piping.
 6. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 7. Closure: Countersunk, drilled-and-threaded plug.
 8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 9. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
 10. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.
- D. Plastic Floor Cleanouts:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Size: Same as connected branch.
 3. Body: PVC.
 4. Closure Plug: PVC.
 5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Fire-stop Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
 - 3. Standard: UL 1479 assembly of sleeve and stack fitting with fire-stopping plug.
 - 4. Size: Same as connected pipe.
 - 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 6. Stack Fitting: ASTM A 48, gray-iron, hubless pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 7. Special Coating: Corrosion resistant on interior of fittings.

2.3 ROOF DRAINS

- A. Metal Roof Drains:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Tyler Pipe; Wade Div.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.21.2M.
 - 3. Pattern: Roof drain.
 - 4. Body Material: Cast iron.
 - 5. Combination Flashing Ring and Gravel Stop: Required.
 - 6. Flow-Control Weirs: Not required.
 - 7. Outlet: Bottom.
 - 8. Dome Material: Cast iron.
 - 9. Extension Collars: Required.
 - 10. Underdeck Clamp: Required.
 - 11. Sump Receiver: Not required.
- B. Plastic Roof Drains
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Zurn Plumbing Products Group; Light Commercial Operation.
 - 2. Standard: ASME A112.21.2M.
 - 3. Pattern: Roof drain.
 - 4. Body Material: ABS or PVC.
 - 5. Combination Flashing Ring and Gravel Stop: Required.
 - 6. Outlet: Bottom.
 - 7. Dome Material: ABS or PVC.
- 8. Underdeck Clamp: Required.

2.4 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Expansion
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected piping.

2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152, 12 oz./sq. ft. thickness.
- B. Zinc-Coated Steel Sheet: ASTM A 653, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
 - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- G. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.1 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.2 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

SECTION 22330 - DOMESTIC WATER HEATERS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following electric water heaters:
 - 1. Flow-control, instantaneous electric water heaters.
 - 2. Thermostat-control, instantaneous electric water heaters.
 - 3. Commercial, storage electric water heaters.
 - 4. Compression tanks.
 - 5. Instantaneous, tankless, gas water heaters.
 - 6. Commercial, high-efficiency, gas water heaters.
 - 7. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data (if requested by Owner): For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings (if requested by Owner): Diagram power, signal, and control wiring.
- C. Product Certificates (if requested by Owner): For each type of commercial and instantaneous electric water heater, signed by product manufacturer.
- D. Manufacturer Seismic Qualification Certification (if requested by Owner): Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Source quality-control test reports (if requested by Owner).
- F. Field quality-control test reports (if requested by Owner).
- G. Operation and Maintenance Data: For electric or gas water heaters to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

- D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period(s): From date of Substantial Completion:
 - a. Instantaneous Electric Water Heaters: Five year(s).
 - b. Commercial Electric Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Three years.
 - c. Instantaneous, Gas Water Heaters:
 - 1) Heat Exchanger: Five years.
 - 2) Controls and Other Components: Three years.
 - d. Commercial, Gas Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Three years.
 - e. Compression Tanks: One year(s).

PART 2 - PRODUCTS

2.0 MANUFACTURERS

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

2.1 INSTANTANEOUS ELECTRIC WATER HEATERS

- A. Flow-Control, Instantaneous Electric Water Heaters: Comply with UL 499 for tankless electric (water heater) heating appliance.
 - 1. Available Manufacturers:
 - a. Hot Aqua, Inc.
 - b. IMI Waterheating, Ltd.
 - c. Stiebel Eltron, Inc.
 - 2. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - 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.
- 4. Capacity and Characteristics:
 - a. See Drawings.
- B. Thermostat-Control, Instantaneous Electric Water Heaters: Comply with UL 499 for tankless electric (water heater) heating appliance.
 - 1. Available Manufacturers:
 - a. IMI Waterheating, Ltd.
 - b. Niagara Industries, Inc.
 - 2. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Thermostat.
 - 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.
 - 4. Capacity and Characteristics:
 - a. See Drawings.

2.2 INSTANTANEOUS, GAS WATER HEATERS

- A. Description: Comply with ANSI Z21.10.3/CSA 4.3, except storage is not required.
 - 1. Available Manufacturers:
 - a. Rinnai
 - b. NORITZ America Corporation.
 - 2. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Heat Exchanger: Copper tubing.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Burner: For use with tankless water heaters and for natural-gas fuel.
 - f. Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
 - g. Temperature Control: Adjustable thermostat.
 - h. Jacket: Metal with enameled finish or plastic.
 - 3. Support: Bracket for wall mounting.
 - 4. Capacity and Characteristics: See Drawings.

2.3 COMMERCIAL ELECTRIC WATER HEATERS

- A. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.
 - 1. Available Manufacturers:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - d. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - e. Smith, A. O. Water Products Company.
 - f. State Industries, Inc.
 - 2. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

- 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
- b. Pressure Rating: 150 psig.
- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
- 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - 1) Staging: Input not exceeding 18 kW per step.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- 4. Special Requirements: NSF 5 construction.
- 5. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
- 6. Capacity and Characteristics:
 - a. See Drawings.

2.4 COMMERCIAL, GAS WATER HEATERS

- A. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 - 1. Available Manufacturers:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - d. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - e. Smith, A. O. Water Products Company.
 - f. State Industries, Inc.
 - 2. Description: Manufacturer's proprietary design to provide at least 90 percent combustion efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.
 - 3. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - 4. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.

- c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
- e. Jacket: Steel with enameled finish.
- f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- 5. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.
- 6. Temperature Control: Adjustable thermostat.
- 7. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
- 8. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
- 9. Draft Hood: Draft diverter; complying with ANSI Z21.12.
- 10. Capacity and Characteristics: See Drawings.

2.5 COMPRESSION TANKS

- A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
 - 1. Available Manufacturers:
 - a. AMTROL Inc.
 - b. Smith, A. O.; Aqua-Air Div.
 - c. State Industries, Inc.
 - d. Watts Regulator Co.
 - 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 3. Capacity and Characteristics: Per water heater manufacturer's recommendations.

2.4 EXPANSION TANKS

- A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
 - 1. Available Manufacturers:
 - a. AMTROL Inc.
 - b. Smith, A. O.; Aqua-Air Div.
 - c. State Industries, Inc.
 - d. Watts Regulator Co.
 - 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 3. Capacity and Characteristics:
 - a. Per water heater manufacturers recommendations.

2.5 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.
- C. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.
- D. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- E. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- F. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.
- H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- I. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig maximum outlet pressure, unless otherwise indicated.
- J. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.
- K. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

PART 3 - EXECUTION

3.0 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install seismic restraints for commercial water heaters. Anchor to substrate.
- D. Install gas water heaters according to NFPA 54.
- E. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-

- heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
 - G. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
 - H. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
 - 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.
 - I. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.
 - 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.
 - J. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - K. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
 - L. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
 - M. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
 - N. Install pressure gage(s) on outlet of commercial electric water- heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
 - O. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
 - P. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
 - Q. Fill water heaters with water.
 - R. Charge compression tanks with air.

3.1 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and instantaneous water heaters.

SECTION 22400 - PLUMBING FIXTURES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories and sinks.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Fixture supports.
 - 5. Water closets.
 - 6. Urinals.
 - 7. Lavatories.
 - 9. Commercial sinks.
 - 10. Water fountains.
 - 11. Service sinks.
 - 12. Service basins.
- B. Related Sections include the following:
 - Division 10 Section "Toilet Accessories."
 - Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- D. FRP: Fiberglass-reinforced plastic.
- E. PMMA: Polymethyl methacrylate (acrylic) plastic.
- F. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings (if requested by Owner): Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" ; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Mop-Service Basins: ANSI Z124.6.
 - 3. Plastic Sinks: ANSI Z124.6.
 - 4. Plastic Urinal Fixtures: ANSI Z124.9.
 - 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 6. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 9. Vitreous-China Fixtures: ASME A112.19.2M.
 - 10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 11. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Faucets: ASME A112.18.1.
 - 4. NSF Potable-Water Materials: NSF 61.
 - 5. Pipe Threads: ASME B1.20.1.
 - 6. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 7. Supply Fittings: ASME A112.18.1.
 - 8. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Manual-Operation Flushometers: ASSE 1037.
 - 4. Plastic Tubular Fittings: ASTM F 409.
 - 5. Brass Waste Fittings: ASME A112.18.2.
 - 6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Flexible Water Connectors: ASME A112.18.6.
 - 2. Floor Drains: ASME A112.6.3.
 - 3. Grab Bars: ASTM F 446.
 - 4. Hose-Coupling Threads: ASME B1.20.7.

5. Hot-Water Dispensers: ASSE 1023 and UL 499.
6. Off-Floor Fixture Supports: ASME A112.6.1M.
7. Pipe Threads: ASME B1.20.1.
8. Plastic Toilet Seats: ANSI Z124.5.

1.5 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 2. Warranty Period for Commercial Applications: One year from date of Certificate of Occupancy.

PART 2 - PRODUCTS

2.0 LAVATORY FAUCETS

- A. Lavatory Faucets:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliant
 - b. Eljer.
 - c. Elkay Manufacturing Co.
 - d. Sloan Valve Company.
 2. Description: Single-control mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.2 gpm.
 - d. Maximum Flow: 1.0 gallon.
 - e. Centers: 4 inches.
 - f. Mounting: Deck, concealed.
 - g. Valve Handle(s): Not applicable.
 - h. Inlet(s): NPS 1/2.
 - i. Spout: Rigid type.
 - j. Spout Outlet: Laminar flow.
 - k. Operation: Manual – standard. Sensor – optional.
 - l. Drain: Grid.
- M. Tempering Device: Thermostatic.

2.1 SERVICE SINK FAUCETS

- A. Sink Faucets:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.
 - b. Eljer.
 - c. Elkay Manufacturing Co.
 - d. T & S Brass and Bronze Works, Inc.
 - e. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two-lever handle.
 - e. Backflow Protection Device for Hose Outlet: Required.
 - f. Centers: 8 inches.
 - g. Mounting: back fall
 - h. Handle(s): Wrist blade, 4 inches.
 - i. Inlet(s): NPS 1/2.
 - j. Spout Type: Rigid, solid brass.
 - k. Spout Outlet: Hose thread.
 - l. Vacuum Breaker: Required.
 - m. Operation: Non-compression, manual.
 - n. Drain: Grid.

2.2 FLUSHOMETERS

- A. Flushometers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Plumbing Products Group; Commercial Brass Operation.
 - b. Sloan Valve Company.
 - c. TOTO USA, Inc.
 2. Description: Flushometer for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm or piston operation.
 - b. Style: Exposed or Concealed.
 - c. Trip Mechanism: Hard-wired, electric-sensor actuator or Battery-operated sensor actuator.

2.3 TOILET SEATS

- A. Toilet Seats:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bemis Manufacturing Company.
 - c. Church Seats.
 - d. Eljer.
 - e. Olsonite Corp.
 2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SC, self-sustaining, check.
 - e. Class: Heavy-duty commercial.
 - f. Color: White.

2.4 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing Co., Inc.
 - b. TCI Products.
 - c. TRUEBRO, Inc.
 - d. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.5 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
 2. Smith, Jay R. Mfg. Co.
 3. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 4. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Urinal Supports:
1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 2. Wall mounted.
 3. Accessible-Fixture Support: Include rectangular steel uprights.
- C. Lavatory Supports:
1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Sink Supports:
1. Description: Type I, sink carrier with exposed arms and tie rods for sink-type fixture. Include steel uprights with feet.
 2. Floating sink.

2.6 WATER CLOSETS

- A. Water Closets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Eljer.
 - c. Kohler Co.
 - d. Crane
 2. Description: Floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: Flushometer valve.
 - 1) Flush: Standard.
 - 2) Auto flush: Optional.
 - 3) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - 4) Height: Standard.

- 5) Design Consumption: 1.6 gal./flush.
- 6) Color: White.
- B. Water Closets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eljer.
 - b. Kohler Co.
 - c. American Standard Companies, Inc.
 - d. Crane
 - 2. Description Accessible, floor-mounting, back-outlet, vitreous-china fixture designed for flushometer-valve operation.
 - a. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - 2) Height: Accessible.
 - 3) Design Consumption: 1.6 gal./flush.
 - 4) Color: White.

2.7 URINALS

- A. Urinals:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Eljer.
 - d. Kohler Co.
 - e. Crane
 - 2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Type: Siphon jet.
 - b. Strainer or Trapway: Separate removable strainer with integral trap.
 - c. Design Consumption: 1 gal./flush.
 - d. Color: White.
 - e. Fixture Support: Urinal chair carrier.

2.8 LAVATORY

- A. Commercial Sinks:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eljer
 - b. Elkay Manufacturing Co.
 - c. Crane
 - d. American Standard Companies, Inc.
 - 2. Description: One-compartment, wall-hung, stainless-steel commercial sink with backsplash.
 - a. Compartment:
 - 1) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
 - a) Location: Centered in compartment.
 - b. Faucet(s): Sink.
 - 1) Number Required: One.
 - 2) Mounting: Backsplash.
 - b. Supplies: NPS 3/4 chrome-plated copper with stops or PVC shutoff valves.
 - c. Drain Piping: NPS 2 and wall escutcheon(s).
- B. Commercial Sinks ADA Compliant:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eljer
 - b. Elkay Manufacturing Co.
 - c. Crane
 - d. American Standard Companies, Inc.
2. Description: One-compartment, wall-hung, cast-iron ceramic lavatory with backsplash.
 - a. Compartment:
 - 1) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
 - a) Location: Centered in compartment.
 - b. Faucet(s): Sink.
 - 1) Number Required: One.
 - 2) Mounting: Backsplash.
 - c. Supplies: NPS 3/4 chrome-plated copper with stops or PVC shutoff valves.
 - d. Drain Piping: NPS 2 and wall escutcheon(s).

2.9 SERVICE BASINS

- A. Service Sink:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Florestone Products Co., Inc.
 - c. Swan Corporation.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
 - e. American Standard Industries, Inc.
 2. Description: Flush-to-wall, floor-mounting, enameled cast-iron with rim guard.
 - a. Shape: Square.
 - b. Size: 24 by 20 inches.
 - c. Height: 10 inches.
 - e. Color: White.
 - f. Faucet: Sink.
 - g. 3" Waste
- B. Mop Sink
 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Fiat
 2. Description
 - a. Shape: Square.
 - b. Size: 23 by 22 inches.
 - c. Capacity: 20 gallons
 - e. Color: White.
 - f. Fiberglass
 - g. Faucet: Deck type
 - h. 2" Waste

2.10 EYEWASH

- A. Eyewash Manufacturer: Guardian model G1825HFCHSDCP
 1. Description:
 - a. Pedestal mounted
 - b. Safety Orange ABS Plastic Bowl
 - c. Plated Brass Supply Arms
 - d. ANSI compliant identification sign
 - e. Auxiliary hand-held drench hose

- f. Protective head covers
 - g. Two fine spray heads
- B. Mixing valve Manufacturer: Lawler 911E/F
 - 1. Description:
 - a. Thermostatic to provide 85 degree F water to eyewash.
 - b. Hot water port control mechanism
 - c. Max. inlet pressure 125 psi.
 - d. 1/2" connections
 - e. 7 gpm at 30 psi.
 - f. Liquid filled thermostat

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- M. Install toilet seats on water closets.
- N. Install trap-seal liquid in dry urinals.
- O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

- P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- R. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- S. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
- T. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- U. Set Mop Sink in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.4 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms when used.
- E. Test eyewash for proper operation.

3.5 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.6 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.
- C. Check ADA clearances.

SECTION 23050 - COMMON WORK RESULTS FOR HVAC**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates (if requested by Owner).

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight and support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS**2.0 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a.. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.3 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Epco Sales, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Epco Sales, Inc.

- b. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Central Plastics Company.
 - c. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Co.
 - c. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION**3.0 HVAC DEMOLITION**

- A. Refer to Division 01 Section "Project Coordination" and Division 02 Section "Demolition" for general demolition requirements and procedures.
- B. If applicable, disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.1 PIPING SYSTEMS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

- 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 Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 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 above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Pipe Sleeves: For pipes smaller than NPS 6.

- b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
- 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position the pipe in the center of the sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position the pipe in the center of the sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Refer to Division 07 Section "Penetration Fire-stopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846 Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install the HVAC equipment to facilitate servicing and maintenance of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

SECTION 23051 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 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**2.0 GENERAL MOTOR REQUIREMENTS**

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.1 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.2 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- D. Multi-speed Motors: Separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.

- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

2.3 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Variable Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.4 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multi-speed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

Not Applicable

SECTION 23052 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal-bellows expansion joints.
 - 2. Expansion compensators.
 - 3. Rubber expansion joints.
 - 4. Flexible-hose expansion joints.
 - 5. Packed slip expansion joints.
 - 6. Flexible ball joints.
 - 7. Pipe bends and loops.
 - 8. Alignment guides and anchors.

1.2 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated.
- B. Delegated-Design Submittal (if requested by Owner): For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates (if requested by Owner).
- D. Product Certificates (if requested by Owner): For each type of pipe expansion joint, signed by product manufacturer.
- E. Maintenance Data: For pipe expansion joints to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS**2.0 EXPANSION JOINTS**

- A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
 - 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. Expansion Joint Systems, Inc.
 - b. Flex-Weld, Inc.
 - c. Metraflex, Inc.
 - d. Unaflex Inc.
 - 2. Metal-Bellows Expansion Joints for Copper Piping: Single- or multiple-ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
 - 3. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections, and steel shroud.
 - 4. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple-ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
 - 5. Minimum Pressure Rating: 175 psig, unless otherwise indicated.
 - 6. Configuration: Single- or double-bellows type, unless otherwise indicated.
 - 7. End Connections: Flanged or weld.
- B. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, anti-torque device, and removable end clip for positioning.
 - 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. Flex-Pression, Ltd.
 - b. Metraflex, Inc.
 - c. Unaflex Inc.
 - 2. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
 - 3. Configuration for Copper Piping: Two-ply phosphor-bronze or stainless-steel bellows and bronze or stainless-steel shroud.
 - 4. Configuration for Steel Piping: Two-ply stainless-steel bellows and carbon-steel shroud.
 - 5. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - 6. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
 - 7. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
 - 8. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or threaded.
- C. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 - 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. Flexicraft Industries.
 - b. Metraflex, Inc.
 - c. Unaflex Inc.
 - 2. Arch Type: Single or multiple arches.
 - 3. Spherical Type: Single or multiple spheres.
 - a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
 - b. Minimum Pressure and Temperature Ratings for NPS 5 and NPS 6: 140 psig at 200 deg F.
 - c. Minimum Pressure and Temperature Ratings for NPS 8 to NPS 12: 140 psig at 180 deg F.
 - 4. Material: EPDM.
 - 5. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
- D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
 - 1. Manufacturers: 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. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex-Pression, Ltd.

- d. Metraflex, Inc.
- 2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
- 3. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
- 4. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - c. NPS 8 to NPS 12: Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
- 5. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
 - c. NPS 8 and Larger: Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.
- E. Packed Slip Expansion Joints: ASTM F 1007, carbon-steel, packing type designed for repacking under pressure and pressure rated for 250 psig at 400 deg F minimum. Include asbestos-free PTFE packing, compound limit stops, and drip connection if used for steam 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. Adscos Manufacturing, LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Hyspan Precision Products, Inc.
 - 2. Configuration: Single- and double-joint class.
 - 3. End Connections: Flanged or weld ends to match piping system.
- F. Flexible Ball Joints: Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection, and 250 psig at 400 deg F minimum pressure rating; complying with ASME Boiler and Pressure Vessel Code: Section II, "Materials," and with ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
 - 1. Angular Deflection for NPS 6 and Smaller: 30-degree minimum.
 - 2. Angular Deflection for NPS 8 and Larger: 15-degree minimum.
 - 3. End Connections for NPS 2 and Smaller: Threaded.
 - 4. End Connections for NPS 2-1/2 and Larger: Flanged.
 - 5. 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. Advanced Thermal Systems, Inc.
 - b. Hyspan Precision Products, Inc.

2.1 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 - 1. Manufacturers: 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. Advanced Thermal Systems, Inc.
 - b. Flexicraft Industries.
 - c. Metraflex, Inc.
 - d. Piping Technology & Products, Inc.

2.2 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - 3. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.0 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.1 PIPE BEND AND LOOP INSTALLATION

- A. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.2 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.4 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

SECTION 23053 – GENERAL DUTY VALVES FOR HVAC PIPING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Brass ball valves.
 - 3. Bronze ball valves.
 - 4. Iron ball valves.
 - 5. Iron, single-flange butterfly valves.
 - 6. Iron, grooved-end butterfly valves.
 - 7. High-performance butterfly valves.
 - 8. Bronze lift check valves.
 - 9. Bronze swing check valves.
 - 10. Iron swing check valves.
 - 11. Iron swing check valves with closure control.
 - 12. Iron, grooved-end swing-check valves.
 - 13. Iron, center-guided check valves.
 - 14. Iron, plate-type check valves.
 - 15. Bronze gate valves.
 - 16. Iron gate valves.
 - 17. Bronze globe valves.
 - 18. Iron globe valves.
 - 19. Lubricated plug valves.
 - 20. Eccentric plug valves.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of valve indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand-wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.0 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Hand-wheel: For valves other than half-turn types.
 3. Hand-lever: For quarter and half turn valves NPS 6 and smaller except plug valves.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.1 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

- d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Hand-wheel: Malleable iron.
- B. Class 125, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.
- C. Class 150, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Hand-wheel: Malleable iron.
- D. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.

2.2 BRASS BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:

- a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two-piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.
- C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Legend Valve.
 - b. Marwin Valve; a division of Richards Industries.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two-piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.
- D. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jamesbury; a subsidiary of Metso Automation.
 - b. Marwin Valve; a division of Richards Industries.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Brass or bronze.
 - f. Ends: Threaded.

- g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Regular.
- E. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three-piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- F. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - b. Marwin Valve; a division of Richards Industries.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three-piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Legend Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two-piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.

- h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two-piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.
- C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two-piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.
- D. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Jenkins Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two-piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Regular.
- E. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three-piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- F. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three-piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.4 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- B. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- C. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.
- D. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.

- b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.
- E. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.
- F. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.
- G. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.
 - b. Kitz Corporation.
 - c. Legend Valve.

- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
 - h. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- I. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.
- J. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.

- e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.
- K. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.
- L. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.6 IRON, GROOVED-END BUTTERFLY VALVES

- A. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tyco Fire Products LP; Grinnell Mechanical Products.
 - b. Victaulic Company.
 - 2. Description:

- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.
- B. 300 CWP, Iron, Grooved-End Butterfly Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. NIBCO INC.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. NPS 8 and Smaller CWP Rating: 300 psig.
 - c. NPS 10 and Larger CWP Rating: 200 psig.
 - d. Body Material: Coated, ductile iron.
 - e. Stem: Two-piece stainless steel.
 - f. Disc: Coated, ductile iron.
 - g. Seal: EPDM.

2.7 HIGH-PERFORMANCE BUTTERFLY VALVES

- A. Class 150, Single-Flange, High-Performance Butterfly Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - 2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.
- B. Class 300, Single-Flange, High-Performance Butterfly Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - 2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 720 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, or ductile iron.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.

- g. Disc: Carbon steel.
- h. Service: Bidirectional.

2.8 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Lift Check Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.9 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.
- C. Class 150, Bronze Swing Check Valves with Bronze Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.10 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Kitz Corporation.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

- B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Composition.
 - h. Seat Ring: Bronze.
 - i. Disc Holder: Bronze.
 - j. Disc: PTFE or TFE.
 - k. Gasket: Asbestos free.
- C. Class 250, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.11 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever and Spring-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.
 - i. Closure Control: Factory-installed, exterior lever and spring.
- B. Class 125, Iron Swing Check Valves with Lever and Weight-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.
 - i. Closure Control: Factory-installed, exterior lever and weight.

2.12 IRON, GROOVED-END SWING CHECK VALVES

- A. 300 CWP, Iron, Grooved-End Swing Check Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire Products LP; Grinnell Mechanical Products.
 - c. Victaulic Company.
 2. Description:
 - a. CWP Rating: 300 psig.
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring operated, ductile iron or stainless steel.

2.13 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Compact wafer.
 - f. Seat: Bronze.
- B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: Bronze.
- C. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: Bronze.
- D. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: EPDM or NBR.
- E. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: EPDM or NBR.

2.14 IRON, PLATE-TYPE CHECK VALVES

- A. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 250 psig.
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - f. Seat: Bronze.
- B. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 126, gray iron.
 - f. Seat: Bronze.
- C. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 400 psig.
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - f. Seat: Bronze.
- D. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 126, gray iron.
 - f. Seat: EPDM or NBR.
- E. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 250 psig.
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 395 or ASTM A 536, ductile iron.
 - f. Seat: EPDM or NBR.
- F. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 126, gray iron.
 - f. Seat: EPDM or NBR.

2.15 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.
- B. Class 125, RS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.
- C. Class 150, NRS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.
- D. Class 150, RS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.

2.16 IRON GATE VALVES

- A. Class 125, NRS, Iron Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.
- B. Class 125, OS&Y, Iron Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.
- C. Class 250, NRS, Iron Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet
 - e. Ends: Flanged.

- f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.
- D. Class 250, OS&Y, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.

2.17 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Hand-wheel: Malleable iron.
- B. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.
- C. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.

- c. NIBCO INC.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Hand-wheel: Malleable iron.

2.18 IRON GLOBE VALVES

- A. Class 125, Iron Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
- B. Class 250, Iron Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.19 LUBRICATED PLUG VALVES

- A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Pattern: Venturi.

- f. Plug: Cast iron or bronze with sealant groove.
- B. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milliken Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Pattern: Venturi.
 - f. Plug: Cast iron or bronze with sealant groove.
- C. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Pattern: Venturi.
 - f. Plug: Cast iron or bronze with sealant groove.
- D. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milliken Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Pattern: Venturi.
 - f. Plug: Cast iron or bronze with sealant groove.

2.20 ECCENTRIC PLUG VALVES

- A. 175 CWP, Eccentric Plug Valves with Resilient Seating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milliken Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-108.
 - b. CWP Rating: 175 psig minimum.
 - c. Body and Plug: ASTM A 48, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.
 - d. Bearings: Oil-impregnated bronze or stainless steel.
 - e. Ends: Flanged.
 - f. Stem-Seal Packing: Asbestos free.
 - g. Plug, Resilient-Seating Material: Suitable for potable-water service unless otherwise indicated.

PART 3 - EXECUTION**3.0 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: Globe, ball, or butterfly valves.
 - 4. Throttling Service, Steam: Globe or angle valves.
 - 5. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

SECTION 23054 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 - 4. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 5. Division 23 Sections "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry, Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner): For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.

- B. Shop Drawings (if requested by Owner): Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Fiberglass strut systems. Include Product Data for components.
 - 4. Pipe stands. Include Product Data for components.
 - 5. Equipment supports.
- C. Welding certificates (if requested by Owner).

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Grinnell Corp.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Unistrut Corp.; Tyco International, Ltd.

- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.
 - 1. Manufacturers:
 - a. Plasti-Fab, Inc.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-4, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Thomas & Betts Corporation.
 - 3. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FIBERGLASS STRUT SYSTEMS

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-4, made of fiberglass channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Cope, T. J., Inc.; Tyco International Ltd.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Pipe Shields, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.

2.8 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.9 EQUIPMENT SUPPORTS

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

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and non-metallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, non-corrosive, and non-gaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.0 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. 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 non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
 - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 - 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 - 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 - 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 - 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. 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 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. 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.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb 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 absorb 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 absorb 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.1 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. 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.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
 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 according to ASME B31.1 for power piping and 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. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 5. Pipes NPS 8 and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

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

3.4 ADJUSTING

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

3.5 PAINTING

- 1. Refer to Division 09 Painting Sections.

SECTION 23055 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Freestanding and restrained air-mounting system.
 - 12. Restrained vibration isolation roof-curb rails.
 - 13. Seismic snubbers.
 - 14. Restraining braces and cables.
 - 15. Steel and inertia, vibration isolation equipment bases.

1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. In accordance with code and acceptable to the authority having jurisdiction.
- B. Seismic-Restraint Loading:
 - 1. In accordance with code and acceptable to the authority having jurisdiction.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner): For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

- B. Delegated-Design Submittal (if requested by Owner): For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Seismic and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings (if requested by Owner): Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates (if requested by Owner).
- E. Qualification Data (if requested by Owner): For professional engineer and testing agency.
- F. Air-Mounting System Performance Certification (if requested by Owner): Include natural frequency, load, and damping test data performed by an independent agency.
- G. Field quality-control test reports (if requested by Owner).
- H. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage pre-approval OPA number from OSHPD, pre-approval by ICC-ES, or pre-approval by another agency acceptable to authorities having jurisdiction, showing

maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.0 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
 - 1. California Dynamics Corporation.
 - 2. Mason Industries.
 - 3. Vibration Eliminator Co., Inc.
- D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel base-plates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with base-plate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- F. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- G. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - 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. Base-plates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to base-plate underside. Base-plates shall limit floor load to 500 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- H. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled base-plate bonded to 1/4-inch thick, neoprene or rubber isolator pad attached to base-plate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- I. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- J. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- K. Spring Hangers: 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. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- L. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 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. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

- N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and replaceable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.1 AIR-MOUNTING SYSTEMS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. California Dynamics Corporation.
 - 2. Vibration Eliminator Co., Inc.
- D. Air Mounts: Freestanding, single or multiple, compressed-air bellows.
 - 1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows.
 - 2. Maximum Natural Frequency: 3 Hz.
 - 3. Operating Pressure Range: 25 to 100 psig.
 - 4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
 - 5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch.
- E. Restrained Air Mounts: Housed compressed-air bellows.
 - 1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows and spring, with angle-iron frame having vertical-limit stops and channel-section top with leveling adjustment and attachment screws.
 - 2. Maximum Natural Frequency: 3 Hz.
 - 3. Operating Pressure Range: 25 to 100 psig.
 - 4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
 - 5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. California Dynamics Corporation.
 - 2. Thybar Corporation.
 - 3. Vibration Eliminator Co., Inc.
- D. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- E. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces.

- Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- F. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or wind restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - a. Resilient Material: Oil and water resistant standard neoprene.
 - G. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
 - H. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter-flashed over roof materials.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. California Dynamics Corporation.
 - 2. Vibration Eliminator Co., Inc.
- D. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- E. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 1. California Dynamics Corporation.
 2. Hilti, Inc.
 3. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.
- F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with 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; and rated in tension, compression, and torsion forces.
- G. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- H. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- I. 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.
- J. 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.
- K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic and wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- 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 seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install seismic 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. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- 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. Drilled-in 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 the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed 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 Anchors: 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Hydronic Piping" for piping flexible connections.

3.4 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. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
 - 11. Test and adjust air-mounting system controls and safeties.

12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust the isolators after the piping 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.
- C. Adjust air-spring leveling mechanism.
- D. Adjust active height of spring isolators.
- E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 DEMONSTRATION

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

SECTION 23056 - TESTING, ADJUSTING AND BALANCING FOR HVAC**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Dual-duct systems.
 - c. Variable-air-volume systems.
 - d. Multizone systems.
 - e. Induction-unit systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
 - c. Primary-secondary hydronic systems.

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 entity engaged to perform TAB Work.

1.3 SUBMITTALS

- A. Qualification Data (if requested by Owner): Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report (if requested by Owner): 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 (if requested by Owner): Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports (if requested by Owner).
- E. Sample report forms (if requested by Owner).
- F. Instrument calibration reports, to include the following (if requested by Owner):
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.

2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Area Construction Manager on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by the Engineer of Record.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 PROJECT 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.

1.6 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.0 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 systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

- E. Examine ceiling plenums and under-floor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts and Nonmetal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. 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.

3.1 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets 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. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.3 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.4 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 sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure the airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Engineer of Record for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. 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 will occur. Measure the 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 within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.5 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.

3.6 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.7 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply and Return Fans: Zero to plus 10 percent.
 2. Exhaust and Equipment with Fans: Zero to plus 10 percent..
 3. Air Outlets and Inlets: Plus or minus 10 percent.

3.8 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: 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.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; 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 contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.

- h. Other system operating conditions that affect performance.
- 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. Pipe and valve sizes and locations.
 - 4. Balancing stations.
 - 5. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Cooling-coil static-pressure differential in inches wg.
 - g. Heating-coil static-pressure differential in inches wg.
 - h. Outdoor airflow in cfm.
 - i. Return airflow in cfm.
 - j. Outdoor-air damper position.
 - k. Return-air damper position.
- F. Apparatus-Coil Test Reports:
 - 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.

- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Refrigerant expansion valve and refrigerant types.
 - i. Refrigerant suction pressure in psig.
 - j. Refrigerant suction temperature in deg F.
- G. Gas Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Air flow rate in cfm.

- c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- K. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.10 INSPECTIONS

- A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner's Representative.
 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner's Representative.
 3. Owner's representative may randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 4. 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."
 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports. Submit to General Contractor and Owner

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.

SECTION 23070 - HVAC INSULATION**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Calcium silicate.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.
 - e. Fire-rated insulation systems.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Tapes.
 - 9. Securements.
 - 10. Corner angles.
- B. Related Sections:
 - 1. Division 21 Section "Fire-Suppression Systems Insulation."
 - 2. Division 22 Section "Plumbing Insulation."
 - 3. Division 23 Section "Metal Ducts" for duct liners.

1.2 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings (if requested by Owner):
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.
- C. Qualification Data (if requested by Owner): For qualified Installer.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for application of piping insulation duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing if applicable.

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.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.0 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group; Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; AP Armaflex.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket or III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Owens Corning; All-Service Duct Wrap.
- J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Johns Manville; 800 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.
- K. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
- L. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Knauf Insulation; Permawick Pipe Insulation.
- b. Owens Corning; VaporWick Pipe Insulation.
- M. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.1 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Thermal Ceramics; FireMaster Duct Wrap.
 - b. Unifrax Corporation; FyreWrap.

2.2 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-97.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
 - c. Marathon Industries, Inc.; 290.
 - d. Vimasco Corporation; 760.
- C. Cellular-Glass, Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW TACC, Division of Illinois Tool Works; CB-50.
 - b. Marathon Industries, Inc.; 590.
 - c. Mon-Eco Industries, Inc.; 55-40.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Vimasco Corporation; 750.
 2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Vimasco Corporation; 750.
 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 4. Permanently flexible, elastomeric sealant.
 5. Service Temperature Range: Minus 100 to plus 300 deg F.
 6. Color: White or gray.

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 C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.7 TAPES

- A. ASJ Tape: White vapor retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor retarder tape with acrylic adhesive.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

- A. Bands:
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Insulation Pins and Hangers:
 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.

- 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Base-plate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Base-plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Base-plate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Base-plate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 5. Self-Sticking-Base Insulation Hangers: Base-plate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Base-plate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 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 & F Wire.
 - b. Childers Products.

2.9 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing if applicable. Comply with requirements for heat tracing installation that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use de-mineralized 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 equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom 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 application and finishing.
- 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 at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 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.
 - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry the surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.

3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 1. Comply with requirements in Division 07 Section "Penetration Fire-stopping" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Fire-stopping."

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.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted

- tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape any PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement

applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 CALCIUM SILICATE INSULATION INSTALLATION

- A. Insulation Installation on Boiler Breechings and Ducts:
 1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 3. On exposed applications without metal jacket, finish the insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.
- B. Insulation Installation on Straight Pipes and Tubes:
 1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- C. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
 4. Finish flange insulation same as pipe insulation.
- D. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
 3. Finish fittings insulation same as pipe insulation.
- E. Insulation Installation on Valves and Pipe Specialties:
 1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 2. Install insulation to flanges as specified for flange insulation application.
 3. Finish valve and specialty insulation same as pipe insulation.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

- 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 factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed 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 pipe insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as 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 sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.

3.7 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed 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 mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions; where access to top of ductwork is limited, adhesive application to top of ductwork may be omitted.
3. Install capacitor discharge weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space the pins 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions; where access to top of ductwork is limited, adhesive application to top of ductwork may be omitted..

3. Install capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space the pins 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install fire-stopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Fire-stopping."

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.
 3. Indoor, concealed return located in non-conditioned space.
 4. Indoor, exposed return located in non-conditioned space.
 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 7. Outdoor, concealed supply and return.
 8. Outdoor, exposed supply and return.

- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.10 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.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick

SECTION 23112 - FACILITY NATURAL-GAS PIPING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Service meters.
 - 7. Mechanical sleeve seals.
 - 8. Grout.
 - 9. Concrete bases.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, etc.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
 - 3. Minimum Operating Pressure of Service Meter: 5 psig.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars.
 - 6. Dielectric fittings.
 - 7. Mechanical sleeve seals.
 - 8. Escutcheons.
- B. Shop Drawings(if requested by Owner): For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors,

hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
 2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.
- C. Delegated-Design Submittal (if requested by Owner): For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- D. Coordination Drawings (if requested by Owner): Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- F. Qualification Data (if requested by Owner): For qualified professional engineer.
- G. Welding certificates (if requested by Owner).
- H. Field quality-control reports (if requested by Owner).
- I. Operation and Maintenance Data: For motorized gas valves, pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.7 PROJECT CONDITIONS

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

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS**2.0 PIPES, TUBES, AND FITTINGS**

- A. Steel Pipe: ASTM A 53, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234 for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
 - 6. Mechanical Couplings:
 - 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) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Steel bolts, washers, and nuts.
 - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 5. Striker Plates: Steel, designed to protect tubing from penetrations.

6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.
- C. Aluminum Tubing: Comply with ASTM B 210 and ASTM B 241.
 1. Aluminum Alloy: Alloy 5456 is prohibited.
 2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
 3. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper-alloy fittings.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads shall comply with ASME B1.20.3.
- D. PE Pipe: ASTM D 2513, SDR 11.
 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53, black steel, Schedule 40, Type E or S, Grade B.
 3. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or flanged or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 4. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.
 - 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) Lyall, R. W. & Company, Inc.
 - 2) Mueller Co.; Gas Products Div.
 - 3) Perfection Corporation; a subsidiary of American Meter Company.
 - b. PE body with molded-in, stainless-steel support ring.
 - c. Buna-nitrile seals.
 - d. Acetal collets.
 - e. Electro-zinc-plated steel stiffener.
 5. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - 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) Lyall, R. W. & Company, Inc.
 - 2) Mueller Co.; Gas Products Div.
 - 3) Perfection Corporation; a subsidiary of American Meter Company.
 - b. Fiber-reinforced plastic body.
 - c. PE body tube.
 - d. Buna-nitrile seals.
 - e. Acetal collets.
 - f. Stainless-steel bolts, nuts, and washers.
 6. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

- 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) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
- b. Steel flanges and tube with epoxy finish.
- c. Buna-nitrile seals.
- d. Steel bolts, washers, and nuts.
- e. Factory-installed anode for steel-body couplings installed underground.

2.1 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig.
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72 inches.
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- D. Basket Strainers:
 - 1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 60 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- E. T-Pattern Strainers:
 - 1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 - 2. End Connections: Grooved ends.
 - 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 - 4. CWP Rating: 750 psig.
- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.2 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.3 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
 - 1. CWP Rating: 125 psig.
 - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Threaded-body pack-nut design with adjustable-stem packing.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig.
 - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
 - 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. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Cast-Iron, Non-lubricated Plug Valves: MSS SP-78.
 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. McDonald, A. Y. Mfg. Co.
 - b. Mueller Co.; Gas Products Div.
 - c. Xomox Corporation; a Crane company.
 2. Body: Cast iron, complying with ASTM A 126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with natural gas.
 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Cast-Iron Lubricated Plug Valves: MSS SP-78.
 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. Flowserve.
 - b. Homestead Valve; a division of Olson Technologies, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Milliken Valve Company.
 - e. Mueller Co.; Gas Products Div.
 - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
 2. Body: Cast iron, complying with ASTM A 126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with natural gas.
 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- H. PE Ball Valves: Comply with ASME B16.40.
 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. Kerotest Manufacturing Corp.

- b. Lyall, R. W. & Company, Inc.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
- 2. Body: PE.
- 3. Ball: PE.
- 4. Stem: Acetal.
- 5. Seats and Seals: Nitrile.
- 6. Ends: Plain or fusible to match piping.
- 7. CWP Rating: 80 psig.
- 8. Operating Temperature: Minus 20 to plus 140 deg F.
- 9. Operator: Nut or flat head for key operation.
- 10. Include plastic valve extension.
- 11. Include tamperproof locking feature for valves where indicated on Drawings.
- I. Valve Boxes:
 - 1. Cast-iron, two-section box.
 - 2. Top section with cover with "GAS" lettering.
 - 3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
 - 4. Adjustable cast-iron extensions of length required for depth of bury.
 - 5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.4 MOTORIZED GAS VALVES

- A. Automatic Gas Valves: Comply with ANSI Z21.21.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Honeywell International Inc.
 - b. Johnson Controls.
 - 3. Body: Brass or aluminum.
 - 4. Seats and Disc: Nitrile rubber.
 - 5. Springs and Valve Trim: Stainless steel.
 - 6. Normally closed.
 - 7. Visual position indicator.
 - 8. Electrical operator for actuation by appliance automatic shutoff device.
- B. Electrically Operated Valves: Comply with UL 429.
 - 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. Magnatrol Valve Corporation.
 - b. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
 - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - 2. Pilot operated.
 - 3. Body: Brass or aluminum.
 - 4. Seats and Disc: Nitrile rubber.
 - 5. Springs and Valve Trim: Stainless steel.
 - 6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
 - 7. NEMA ICS 6, Type 4, coil enclosure.
 - 8. Normally closed.
 - 9. Visual position indicator.

2.5 EARTHQUAKE VALVES

- A. Earthquake Valves: Comply with ASCE 25.
 - 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. Pacific Seismic Products, Inc.
 - 2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 3. Maximum Operating Pressure: 7 psig.
 - 4. Cast-aluminum body with stainless-steel internal parts.
 - 5. Nitrile-rubber, reset-stem o-ring seal.
 - 6. Valve position, open or closed, indicator.
 - 7. Composition valve seat with clapper held by spring or magnet locking mechanism.
 - 8. Level indicator.
 - 9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.6 PRESSURE REGULATORS

- A. General Requirements:
 - 1. Single stage and suitable for natural gas.
 - 2. Steel jacket and corrosion-resistant components.
 - 3. Elevation compensator.
 - 4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. Service Pressure Regulators: Comply with ANSI Z21.80.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Meter Company.
 - b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - c. Invensys.
 - 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 - 6. Orifice: Aluminum; interchangeable.
 - 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 - 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 - 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 - 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 - 12. Maximum Inlet Pressure: 100 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Meter Company.
 - b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - c. Invensys.

- d. Maxitrol Company.
 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 12. Maximum Inlet Pressure: 2 psig.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
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. Maxitrol Company.
 2. Body and Diaphragm Case: Die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber.
 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 9. Maximum Inlet Pressure: 1 psig.

2.7 SERVICE METERS

- A. Diaphragm-Type Service Meters: Comply with ANSI B109.2.
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. American Meter Company.
 - b. Invensys.
 2. Case: Die-cast aluminum.
 3. Connections: Steel threads.
 4. Diaphragm: Synthetic fabric.
 5. Diaphragm Support Bearings: Self-lubricating.
 6. Compensation: Continuous temperature and pressure.
 7. Meter Index: Cubic feet.
 8. Meter Case and Index: Tamper resistant.
 9. Remote meter reader compatible.
 10. Maximum Inlet Pressure: 100 psig.
 11. Pressure Loss: Maximum 0.5-inch wg.
 12. Accuracy: Maximum plus or minus 1.0 percent.
- B. Rotary-Type Service Meters: Comply with ANSI B109.3.
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. American Meter Company.
 - b. Invensys.

2. Case: Extruded aluminum.
 3. Connection: Flange.
 4. Impellers: Polished aluminum.
 5. Rotor Bearings: Self-lubricating.
 6. Compensation: Continuous temperature and pressure.
 7. Meter Index: Cubic feet.
 8. Tamper resistant.
 9. Remote meter reader compatible.
 10. Maximum Inlet Pressure: 100 psig.
 11. Accuracy: Maximum plus or minus 2.0 percent.
- C. Service-Meter Bars:
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. American Meter Company.
 - b. Lyall, R. W. & Company, Inc.
 2. Malleable- or cast-iron frame for supporting service meter.
 3. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.
 4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.
- D. Service-Meter Bypass Fittings:
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. Lyall, R. W. & Company, Inc.
 - b. Williamson, T. D., Inc.
 2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
 3. Integral ball-check bypass valve.

2.8 DIELECTRIC FITTINGS

- A. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - b. Wilkins; Zurn Plumbing Products Group.
 2. Minimum Operating-Pressure Rating: 150 psig.
 3. Combination fitting of copper alloy and ferrous materials.
 4. Insulating materials suitable for natural gas.
 5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.
- B. Dielectric 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. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - b. Wilkins; Zurn Plumbing Products Group.
 2. Minimum Operating-Pressure Rating: 150 psig.
 3. Combination fitting of copper alloy and ferrous materials.
 4. Insulating materials suitable for natural gas.
 5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.9 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.

2.10 MECHANICAL SLEEVE SEALS

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

2.11 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
 - 1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated or rough brass.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.12 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.13 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION**3.0 EXAMINATION**

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 or the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 or the International Fuel Gas Code requirements for prevention of accidental ignition.

3.2 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 or the International Fuel Gas Code acceptable to the authority having jurisdiction for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.
- F. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- G. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- H. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- I. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.3 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 or the International Fuel Gas Code acceptable to the authority having jurisdiction for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
 - D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
 - E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
 - F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 - G. Locate valves for easy access.
 - H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
 - I. Install piping free of sags and bends.
 - J. Install fittings for changes in direction and branch connections.
 - K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - d. Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - e. Piping in Equipment Rooms: One-piece, cast-brass type.
 - f. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping:
 - a. Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - b. Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - c. Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
 - d. Piping in Equipment Rooms: Split-casting, cast-brass type.
 - e. Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
 - L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Comply with requirements in Division 07 Section "Penetration Fire-stopping."
 - M. Verify final equipment locations for roughing-in.
 - N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
 - O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
 - P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
 - Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
 - R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.4 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies if required. Comply with requirements in Division 05 Section "Metal Fabrications" for pipe bollards.

3.5 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not over-tighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.8 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.

- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Topcoat: Interior latex (flat).
 - c. Color: Gray.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Topcoat: Interior alkyd (flat).
 - c. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 or the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

3.13 DEMONSTRATION

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

3.14 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
 - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground natural-gas piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- C. Underground, below building, piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat the pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat the underground pipe and fittings with protective coating for steel piping.

3.16 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground:
 - 1. PE valves.
 - 2. NPS 2 and Smaller: Bronze plug valves.
 - 3. NPS 2-1/2 and Larger: Cast-iron, lubricated plug valves.

3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, regular-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, non-lubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.

2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
 1. Two-piece, full-port, bronze ball valves with bronze trim.
 2. Bronze plug valve.
 3. Cast-iron, lubricated plug valve.
- E. Valves in branch piping for single appliance shall be one of the following:
 1. One-piece, bronze ball valve with bronze trim.
 2. Two-piece, full-port, bronze ball valves with bronze trim.
 3. Bronze plug valve.

SECTION 23311 - METAL DUCTS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Supplementary Conditions and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
1. Single-wall rectangular ducts and fittings.
 2. Single-wall round and flat-oval ducts and fittings.
 3. Sheet metal materials.
 4. Duct liner.
 5. Sealants and gaskets.
 6. Hangers and supports.
 7. Seismic-restraint devices.
- B. Related Sections:
1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 3. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of the following products:
1. Liners and adhesives.
 2. Sealants and gaskets.
 3. Seismic-restraint devices.
- B. Shop Drawings (if requested by Owner):
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 main 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 , seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal (if requested by Owner):
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 , including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.
- D. Coordination Drawings (if requested by Owner): Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- E. Welding certificates (if requested by Owner).
- F. Field quality-control reports (if requested by Owner).

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.0 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support

- intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "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."

2.1 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 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. Lindab Inc.
 - b. SEMCO Incorporated.
 - c. Sheet Metal Connectors, Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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."

2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Carbon-Steel Sheets: Comply with ASTM A 1008, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36, 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.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 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. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.
 - 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. Bonded Logic, Inc.
 - b. Reflectix Inc.
 - 2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
 - 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
 - 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
 - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 - 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 - 6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 - 7. Secure transversely oriented liner edges facing the air stream with metal nosing that has either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - 8. Terminate inner ducts with build-outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other build-out means are optional. When utilized, secure build-outs to duct walls with bolts, screws, rivets, or welds.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. 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: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Base: Synthetic rubber resin.
 3. Solvent: Toluene and heptane.
 4. Solids Content: Minimum 60 percent.
 5. Shore A Hardness: Minimum 60.
 6. Water resistant.
 7. Mold and mildew resistant.
 8. VOC: Maximum 395 g/L.
 9. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 10. Service: Indoor or outdoor.
 11. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Non-corrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electro-galvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

- 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. Ductmate Industries, Inc.
 - 2. Hilti Corp.
 - 3. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop or field fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.0 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.1 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 SEISMIC RESTRAINT DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed 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 Anchors: 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 applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "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 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "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.
- D. 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. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. 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. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide drainage and cleanup for wash-down procedures.
 - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. Supply Ducts:
 - 1. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 6.

- d. SMACNA Leakage Class for Round and Flat Oval: 6.
- B. Return Ducts:
 - 1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- C. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- E. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 - 2. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- F. Liner:
 - 1. Supply Air Ducts: Fibrous glass, Type I or Natural fiber, 2 inches thick.
 - 2. Return Air Ducts: Fibrous glass, Type I or Natural fiber, 2 inches thick.
- G. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- H. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

SECTION 23330 - AIR DUCT ACCESSORIES**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Turning vanes.
 - 3. Duct-mounted access doors.
 - 4. Flexible connectors.
 - 5. Flexible ducts.
 - 6. Duct accessory hardware.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

1.2 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings (if requested by Owner): For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings (if requested by Owner): Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports (if requested by Owner).
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS**2.0 MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.1 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, [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]:
 - 1. Duro Dyne Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
 - 5. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 1-inch wg.
- E. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Rear mounted.
 - 6. Screen Material: Aluminum.
 - 7. Screen Type: Bird.
 - 8. 90-degree stops.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 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. Nailor Industries Inc.
 - b. Pottorff; a division of PCI Industries, Inc.
 - c. Ruskin Company.
 - d. Vent Products Company, Inc.
 - 2. Standard leakage rating , with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nailor Industries Inc.
 - b. Pottorff; a division of PCI Industries, Inc.
 - c. Ruskin Company.
 - d. Vent Products Company, Inc.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
 - 6. Blade Axles: Nonferrous metal.
 - 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Aluminum.
- C. Low-Leakage, Steel, Manual Volume Dampers:
 - 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. Nailor Industries Inc.
 - b. Pottorff; a division of PCI Industries, Inc.

- c. Ruskin Company.
 - d. Vent Products Company, Inc.
 - 2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Angle shaped.
 - b. Galvanized-steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch thick.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Blade Seals: Neoprene.
 - 9. Jamb Seals: Cambered aluminum.
 - 10. Tie Bars and Brackets: Galvanized steel.
 - 11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
- 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. Nailor Industries Inc.
 - b. Pottorff, a division of PCI Industries, Inc.
 - c. Ruskin Company.
 - d. Vent Products Company, Inc.
 - 2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Angle-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
 - 6. Blade Axles: Nonferrous metal.
 - 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Blade Seals: Neoprene.
 - 9. Jamb Seals: Cambered aluminum.
 - 10. Tie Bars and Brackets: Aluminum.
 - 11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

- E. Jackshaft:
 - 1. Size: 1-inch 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.
- F. Damper Hardware:
 - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.3 TURNING VANES

- 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. Ductmate Industries, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.4 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, [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]:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.5 FLEXIBLE CONNECTORS

- 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. Ductmate Industries, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.

- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.6 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, [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]:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
 - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 20 to plus 175 deg F.
 - 4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004.
- D. Flexible Duct Connectors:
 - 1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
 - 2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.7 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.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. 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. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect flexible ducts to metal ducts with draw bands.
- M. Install duct test holes where required for testing and balancing purposes.
- N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.1 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

SECTION 23371 - DIFFUSERS, REGISTERS AND GRILLES**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Perforated diffusers.
 - 3. Louver face diffusers.
 - 4. Adjustable bar registers and grilles.
- B. Related Sections:
 - 1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification (if requested by Owner): For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Coordination Drawings (if requested by Owner): Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- D. Source quality-control reports (if requested by Owner).

PART 2 - PRODUCTS**2.0 CEILING DIFFUSERS**

- A. Rectangular and Square Ceiling Diffusers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. Titus.
 - 2. Material: Aluminum.
 - 3. Finish: Baked enamel, white.
 - 4. Face Size: 24 by 24 inches.
 - 5. Face Style: Three cone.
 - 6. Mounting: T-bar.
 - 7. Pattern: Fixed.

8. Dampers: Combination damper and grid.
9. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.
- B. Perforated Diffuser:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. Titus.
 2. Material: Steel backpan and pattern controllers, with aluminum face.
 3. Finish: Baked enamel, white.
 4. Face Size: 24 by 24 inches.
 5. Duct Inlet: Round.
 6. Face Style: Flush.
 7. Mounting: T-bar.
 8. Pattern Controller: None.
 9. Dampers: Combination damper and grid.
 10. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.
- C. Louver Face Diffuser:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. Titus.
 2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material: Aluminum.
 4. Finish: Baked enamel, white.
 5. Face Size: 24 by 24 inches.
 6. Mounting: T-bar.
 7. Pattern: One-way, Two-way, Two-way corner, Three-way, Four-way core style.
 8. Dampers: Combination damper and grid.
 9. Accessories:
 - a. Square to round neck adaptor.
 - b. Adjustable pattern vanes.
 - c. Throw reducing vanes.
 - d. Equalizing grid.
 - e. Plaster ring.
 - f. Safety chain.
 - g. Wire guard.
 - H Sectorizing baffles.
 - i. Operating rod extension.

2.1 REGISTERS AND GRILLES

- A. Adjustable Bar Register:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Price Industries.
 - b. Titus.
- 2. Material: Aluminum.
- 3. Finish: Baked enamel, white.
- 4. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
- 5. Core Construction: Removable.
- 6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
- 7. Frame: 1 inch wide.
- 8.
- 9. Mounting: Countersunk screw.
- 10. Damper Type: Adjustable opposed blade.
- 11. Accessories:
 - a. Rear-blade gang operator.
 - b. Filter.
- B. Adjustable Bar Grille:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. Titus.
 - 2. Material: Aluminum.
 - 3. Finish: Baked enamel, white.
 - 4. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
 - 5. Core Construction: Removable.
 - 6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
 - 7. Frame: 1 inch wide.
 - 8. Mounting: Countersunk screw.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Owner for a determination of final location.
- C. Install diffusers, 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 diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

SECTION 23740 – SPLIT-SYSTEM AIR-CONDITIONERS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Electric-heating coils.
 - 3. Gas furnace.
 - 4. Integral, space temperature controls.

1.2 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electrically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in condensing units. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- E. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- F. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: split-systems shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each split-system, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings (if requested by Owner): Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Wind Loading Qualification Certification (if requested by Owner): Submit certification that specified equipment will withstand wind forces identified in "Performance

Requirements" Article and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Manufacturer Seismic Qualification Certification (if requested by Owner): Submit certification that split-systems, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Coordination Drawings (if requested by Owner): Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural members to which equipment will be attached.
 2. Pads and curbs used for equipment support.
- F. Field quality-control test reports (if requested by Owner).
- G. Operation and Maintenance Data: For split-systems to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

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. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor 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 replace components of split-systems that may fail in materials or workmanship within specified warranty period.
1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: One set for each belt-driven fan.
 - 2. Filters: One set of filters for each air-handling unit.
 - 3. Gaskets: One set for each access door.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation
 - 2. Owner approved equal

2.1 UNIT CASINGS

- A. Unit casings shall be formed, galvanized steel construction with welded assembly. Galvanized steel surfaces shall be bonderized and painted with baked acrylic enamel for complete weather protection. Accessories and components shall match and interlock with all other split system components. Fan coil unit casings shall be fully internally insulated with liner which meets NFPA 25/50 flame spread/smoke developed ratings.

2.2 INDOOR UNITS

- A. Concealed Evaporator-Fan Components:
 - 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 2. Insulation: Faced, glass-fiber duct liner.
 - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 - 4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
 - 5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
 - 6. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23051 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
 - 7. Condensate Drain Pans:
 - a. 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.

- 1) Depth: A minimum of 2 inches deep.
 - b. Single-wall, galvanized-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1 (DN 25).
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- B. Floor-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
 - a. Discharge Grille: Steel with surface-mounted frame.
 - b. Insulation: Faced, glass-fiber duct liner.
 - c. Drain Pans: Galvanized steel, with connection for drain; insulated.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
 4. Fan: Direct drive, centrifugal.
 5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23051 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

2.3 OUTDOOR UNITS

- A. Air-Cooled, Compressor-Condenser Components:
1. 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.
 2. 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.
 - a. Compressor Type: Scroll.
 - b. Refrigerant: R-454B.
 - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
 4. Fan: Aluminum-propeller type, directly connected to motor.
 5. Motor: Permanently lubricated, with integral thermal-overload protection.
 6. Low Ambient Kit: Permits operation down to 45°F (7°C).
 7. Mounting Base: Polyethylene.

2.4 FANS

- A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in

- the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Propeller, shaft mounted on permanently lubricated motor.
- D. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and furnace-mounted frame are anchored to building structure.
- E. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.5 ACCESSORIES

- A. Automatic-reset timer to prevent rapid cycling of compressor.
- B. 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.
- C. Drain Hose: For condensate.

2.6 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated: MERV 8.

2.7 GAS FURNACE

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
 - 1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners: Stainless steel.
 - 1. Fuel: Propane gas.
 - 2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
 - 3. High-Altitude Kit: For Project elevations more than 2000 feet above sea level.
- C. Heat-Exchanger and Drain Pan: Stainless steel.
- D. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
- E. Safety Controls:
 - 1. Gas Control Valve: Two stage.
 - 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in over-current protection.

2.9 CONTROLS

- A. Comply/Coordinate with automatic temperature controls, thermostat, and sequence of operation this section. Refer to mechanical drawings for additional information.

- B. Automatic Temperature Controls:
1. Contractor shall furnish and install all HVAC control boards, sensors, low voltage controls wiring and make termination connections for same. Conductor raceway to be provided by electrical contractor if required for controls wiring. Coordinate installation with electrical contractor.
 2. The contractor shall, after the installation is complete, check and adjust all controls and verify that they are operating properly. The controls shall be warranted against defects in workmanships and material for a period of one (1) year after acceptance by the owner. The contractor shall instruct the owner or the designated representative, in the operation of the temperature controls.
- C. Basic Unit Controls:
1. Control-voltage transformer.
 2. Wall-mounted programmable thermostat with the following features:
 - a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch.
 - d. Manual changeover.
 - e. Adjustable dead-band.
 - f. Exposed set point.
 - g. Exposed indication.
 - h. Degree F indication.
 - i. Unoccupied-period-override push button.
 - j. Data entry and access port to input temperature and humidity set points, occupied and unoccupied periods, and output room temperature and humidity, supply-air temperature, operating mode, and status.
- D. Sequence of Operations: Split DX, Heat Pump, Gas Furnace with Cooling Air Handling Unit (AHU).
1. Contractor shall furnish and/or install all necessary control devices to accomplish the following sequence of operation:
 - a. During occupied hours the supply fans shall operate continuously, and the outside air damper shall open to the minimum scheduled position (adjustable). When the outdoor temperature is above 55°F (adjustable), and the space temperature is 1°F above cooling setpoint, cooling shall be energized in stages (where applicable) until 1°F below setpoint is achieved. When the outdoor temperature is below 55°F (adjustable), and space temperature is above cooling setpoint, cooling shall deenergize, and outside air dampers and return air dampers shall modulate to provide a supply air temperature to satisfy the demand for cooling. If the space temperature falls 1°F below the heating setpoint, and the outdoor damper is at the minimum position, electric heat shall be energized in stages (where applicable) until 1°F above setpoint is achieved.
 - b. During unoccupied hours, the supply fans shall deenergize and the outdoor damper shall close. If the space temperature rises 1°F above the cooling setpoint, the fans shall energize. cooling shall be energized in stages (where applicable). When the space temperature falls below cooling setpoint, cooling and fans shall deenergize. If the space temperature falls below the heating setpoint, the fans shall energize. electric/gas heat shall be energized in stages (where applicable). When the space temperature rises above the heating setpoint, electric/gas heat and fans shall be deenergized.
 - c. A provided or field installed pan overflow switch will disable all fans, cooling, heating, and close outdoor air damper if high water is sensed in the pan.
 - d. Setpoints (adjustable):
 1. Occupied:
 - a. Heating: 70°F

- b. Cooling: 74°F
- 2. Unoccupied:
 - a. Heating: 60°F
 - b. Cooling: 85°F

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of split-systems.
- B. Examine roughing-in for split-systems to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where split systems will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

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. Install roof-mounted, compressor-condenser components on approved equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base (minimum 4"). Polyethylene mounting base is acceptable where approved by AHJ. Roof-mounted compressor-condenser components shall be installed on approved roof stands or curbs. Refer to mechanical drawings for additional information.
 - 2. AHU/gas furnace shall be mounted on raised pad, approved stand, or ceiling hung and shall be installed to fit into the space available and meet minimum clearances from combustible surfaces or for the servicing of the equipment as required by the manufacturer and regulatory requirements. Refer to mechanical drawings for additional information.
 - 3. Install wind and seismic restraints where required according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roof-curb rails are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap.
- B. Install piping adjacent to split-systems to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in Division 23 Section "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Connect supply ducts to AHU/gas furnace with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems 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 forms.

3.4 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit casing.
 - 2. Inspect for visible damage to furnace combustion chamber.
 - 3. Inspect for visible damage to compressor, coils, and fans.
 - 4. Inspect internal insulation.
 - 5. Verify that labels are clearly visible.
 - 6. Verify that clearances have been provided for servicing.
 - 7. Verify that controls are connected and operable.
 - 8. Verify that filters are installed.
 - 9. Clean condenser coil and inspect for construction debris.
 - 10. Clean flue and inspect for construction debris.
 - 11. Connect and purge gas line.
 - 12. Remove packing from vibration isolators.
 - 13. Inspect operation of barometric relief dampers.
 - 14. Verify lubrication on fan and motor bearings.
 - 15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 16. Adjust fan belts to proper alignment and tension.
 - 17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
 - 18. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 19. Operate unit for an initial period as recommended or required by manufacturer.
 - 20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record the flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 - 21. Calibrate thermostats.
 - 22. Adjust and inspect high-temperature limits.
 - 23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

24. Start refrigeration system and measure and record the following when ambient is a minimum of 15°F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke and firestat alarms.
29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.5 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing split-system and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain split-systems. Refer to Division 01 Section "Demonstration and Training."

SECTION 23741 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Hot-gas reheat.
 - 3. Electric-heating coils.
 - 4. Gas furnace.
 - 5. Economizer outdoor- and return-air damper section.
 - 6. Integral, space temperature controls.
 - 7. Roof curbs.

1.2 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electrically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- H. VVT: Variable-air volume and temperature.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

- B. Shop Drawings (if requested by Owner): Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Wind Loading Qualification Certification (if requested by Owner): Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Manufacturer Seismic Qualification Certification (if requested by Owner): Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Coordination Drawings (if requested by Owner): Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which RTUs will be attached.
 - 2. Roof openings
 - 3. Roof curbs and flashing.
- F. Field quality-control test reports (if requested by Owner).
- G. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that may fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
 - 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: One set for each belt-driven fan.
 - 2. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation
 - 2. Owner approved equal

2.1 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 - 1. Exterior Casing Thickness: 0.052 inch thick.
- C. Inner Casing Fabrication Requirements:
 - 1. Inside Casing: Galvanized steel, 0.028 inch thick.
- D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C 1071, Type I.
 - 2. Thickness: 1/2 inch.
 - 3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
 - 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- E. Condensate Drain Pans: Formed sections of galvanized-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
 - 1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
 - 2. Drain Connections: Threaded nipple.

- 3. Pan-Top Surface Coating: Corrosion-resistant compound.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.2 FANS

- A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Propeller, shaft mounted on permanently lubricated motor.
- D. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and RTU-mounted frame are anchored to building structure.
- E. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.3 COILS

- A. Supply-Air Refrigerant Coil:
 - 1. Copper-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
 - 3. Coil Split: Interlaced.
 - 4. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating formed with pitch and drain connections complying with ASHRAE 62.1.
- B. Outdoor-Air Refrigerant Coil:
 - 1. Copper plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
- C. Hot-Gas Reheat Refrigerant Coil:
 - 1. Copper-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
- D. Electric-Resistance Heating:
 - 1. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
 - 2. Over-temperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
 - 3. Over-current Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
 - 4. Control Panel: Unit mounted with disconnecting means and over-current protection. Include the following controls:
 - a. Mercury contactors.
 - b. Step Controller: Pilot lights and override toggle switch for each step.
 - c. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
 - d. Time-delay relay.

- e. Airflow proving switch.

2.4 REFRIGERANT CIRCUIT COMPONENTS

- A. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal over-current and high-temperature protection, internal pressure relief, and crankcase heater.
- B. Refrigeration Specialties:
 - 1. Expansion valve with replaceable thermostatic element.
 - 2. Refrigerant filter/dryer.
 - 3. Manual-reset high-pressure safety switch.
 - 4. Automatic-reset low-pressure safety switch.
 - 5. Minimum off-time relay.
 - 6. Automatic-reset compressor motor thermal overload.
 - 7. Brass service valves installed in compressor suction and liquid lines.
 - 8. Low-ambient kit high-pressure sensor.
 - 9. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
 - 10. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.5 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated: MERV 8.

2.6 GAS FURNACE

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
 - 1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners: Stainless steel.
 - 1. Fuel: Natural gas.
- 2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
- 3. High-Altitude Kit: For Project elevations more than 2000 feet above sea level.
- C. Heat-Exchanger and Drain Pan: Stainless steel.
- D. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
- E. Safety Controls:
 - 1. Gas Control Valve: Two stage.
 - 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.7 DAMPERS

- A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
 - 1. Damper Motor: Modulating with adjustable minimum position.
 - 2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.8 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in over-current protection.

2.9 CONTROLS

- A. Control equipment and sequence of operation are specified in Division 23 Section "Instrumentation and Control for HVAC."
- B. Basic Unit Controls:
 - 1. Control-voltage transformer.
 - 2. Wall-mounted thermostat or sensor with the following features:
 - a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch.
 - d. Manual changeover.
 - e. Adjustable dead-band.
 - f. Exposed set point.
 - g. Exposed indication.
 - h. Degree F indication.
 - i. Unoccupied-period-override push button.
 - j. Data entry and access port to input temperature and humidity set points, occupied and unoccupied periods, and output room temperature and humidity, supply-air temperature, operating mode, and status.
 - 3. Wall-mounted humidistat or sensor with the following features:
 - a. Concealed set point.
 - b. Concealed indication.
 - 4. Remote Wall-Mounted Annunciator Panel for Each Unit:
 - a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
 - b. DDC controller or programmable timer and interface with HVAC instrumentation and control system.
 - c. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.
- C. DDC Controller:
 - 1. Controller shall have volatile-memory backup.
 - 2. Safety Control Operation:
 - a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
 - b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
 - c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28 Section "Fire Detection and Alarm."
 - d. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F.
 - e. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
 - 3. Scheduled Operation: Occupied and unoccupied periods on 365-day clock with a minimum of four programmable periods per day.
 - 4. Unoccupied Period:
 - a. Heating Setback: 55 deg F.
 - b. Cooling Setback: System off.
 - c. Override Operation: Two hours.

5. Supply Fan Operation:
 - a. Occupied Periods: Run fan continuously.
 - b. Unoccupied Periods: Cycle fan to maintain setback temperature.
6. Refrigerant Circuit Operation:
 - a. Occupied Periods: Cycle or stage compressors, and operate hot-gas bypass to match compressor output to cooling load to maintain room temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
 - b. Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.
 - c. Switch reversing valve for heating or cooling mode on air-to-air heat pump.
7. Hot-Gas Reheat-Coil Operation:
 - a. Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles compressor.
 - b. Unoccupied Periods: Reheat not required.
8. Gas Furnace Operation:
 - a. Occupied Periods: Stage burner to maintain room temperature.
 - b. Unoccupied Periods: Cycle burner to maintain setback temperature.
9. Electric-Heating-Coil Operation:
 - a. Occupied Periods: Stage coil to maintain room temperature.
 - b. Unoccupied Periods: Energize coil to maintain setback temperature.
10. Economizer Outdoor-Air Damper Operation:
 - a. Occupied Periods: Open to for minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F. Use mixed-air temperature and select between outdoor-air and return-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
 - b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

2.10 ROOF CURBS

- A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C 1071, Type I or II.
 - b. Thickness: 1-1/2 inches.
 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C 916, Type I.
- C. Curb Height: 14 inches.
- D. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for wind-load requirements.

PART 3 - EXECUTION**3.0 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- B. Install wind and seismic restraints according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roof-curb rails are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap.
- B. Install piping adjacent to RTUs to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in Division 23 Section "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
 - 4. Install return-air duct continuously through roof structure.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit casing.
 - 2. Inspect for visible damage to furnace combustion chamber.
 - 3. Inspect for visible damage to compressor, coils, and fans.
 - 4. Inspect internal insulation.
 - 5. Verify that labels are clearly visible.
 - 6. Verify that clearances have been provided for servicing.
 - 7. Verify that controls are connected and operable.
 - 8. Verify that filters are installed.
 - 9. Clean condenser coil and inspect for construction debris.
 - 10. Clean flue and inspect for construction debris.
 - 11. Connect and purge gas line.
 - 12. Remove packing from vibration isolators.
 - 13. Inspect operation of barometric relief dampers.
 - 14. Verify lubrication on fan and motor bearings.
 - 15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 16. Adjust fan belts to proper alignment and tension.
 - 17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
 - 18. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 19. Operate unit for an initial period as recommended or required by manufacturer.
 - 20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record the flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 - 21. Calibrate thermostats.
 - 22. Adjust and inspect high-temperature limits.
 - 23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 - 24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
 - 25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 - 26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
 - 27. Simulate maximum cooling demand and inspect the following:

- a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
- 28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke and firestat alarms.
- 29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.5 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01 Section "Demonstration and Training."

SECTION 23750 – INFRARED RADIANT TUBE HEATERS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes indoor infrared radiant tube heaters.

1.2 SUBMITTALS

- A. Product Data (if requested by Owner): Include manufacturer's technical data for each specified unit, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings (if requested by Owner). Furnish 4 copies of the engineering specification form, showing physical dimensions, installation detail, recommendations, control wiring diagrams, and spare parts list.
- C. Manufacturer Seismic Qualification Certification (if requested by Owner): Submit certification that radiant heaters, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Coordination Drawings (if requested by Owner): Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which Heaters will be attached.
- E. Field quality-control test reports (if requested by Owner).
- F. An Installation, Operation, and Maintenance Manual shall be supplied with each heater.
- G. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Radiant tube heaters shall be furnished and installed in accordance with governing codes and as shown per drawing(s) provided.
- B. Radiant tube heaters shall be Design Certified by CSA and comply with current Occupational Safety and Health Act (OSHA) Requirements. The supplier shall provide the CSA Certification Number and the heaters shall bear the CSA Seal of Certification. The heaters low fire and high fire modes of operation must be Design Certified by CSA.
- C. Installation of equipment must be performed by a contractor qualified in the installation and service of equipment supplied by the manufacturer and conform to all requirements set forth in the manufacturer's manuals and all applicable governmental authorities.

1.4 WARRANTY

- A. Special Warranty: The manufacturer shall provide a written limited warranty covering the heavy one-piece cast iron burner for a period of ten (10) years, the emitter tube for a

period of five (5) years and all components utilized in the heater's control assembly for a period of one (1) year.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Space Ray
 - 2. Robert Gordon Products: Vantage II CTH3-Lit

2.1 PRODUCT REQUIREMENTS

- A. The heater's burner shall consist of a heavy-duty cast iron atmospheric burner. The flame characteristics shall be highly luminous for maximum radiant heat transfer through the emitter tube wall.
- B. The heater's emitter tube shall operate at an average surface temperature of 700°F - 800°F and shall be made of 16-gauge calorized aluminized steel or calorized titanium alloy Alumi-Therm steel (4" O.D.). The emitter tube shall be calorized for longevity, corrosion resistance, and high radiant efficiency. The measured surface emissivity shall be 0.83 - 0.86 at operating temperature. The calorization process shall produce an emitter tube that is highly radiant absorptive (0.95) on the interior and highly radiant emissive (0.83-0.86) on the exterior. The system shall have a radiant efficiency (or radiant coefficient) of 58%.
- C. The heaters shall operate under negative pressure at all times during operation to preclude the escape of combustion gases inside the building. The heater exhaust assembly shall include a 120-volt draft inducer. The draft inducer shall be equipped with a permanently lubricated, totally enclosed and shielded, fan cooled, and heavy-duty ball bearing motor. The motor shall not require maintenance or lubrication for the life of the unit. The draft inducer assembly shall be capable of rotating 90° for vertical or horizontal venting.
- D. The heaters will be CSA design certified for vertical or horizontal venting, maximum 75 feet horizontal sidewall venting, and for 50 feet outside combustion air inlet duct. There shall be no draft hoods. The combustion chamber shall be totally enclosed.
- E. The heaters shall utilize factory assembled, highly efficient aluminum reflectors with a reflectivity of 97.5%. The reflector ends shall be enclosed for maximum radiant heat output and minimum convection losses.
- F. The heaters shall be factory assembled and tested.
- G. Heaters shall operate satisfactorily in any position from horizontal to forty-five degrees (45°) from horizontal, and incline mounted up to 2/12 pitch, and shall be suitable for vented/indirect vented applications.
- H. Heaters shall be design certified by the American National Standard Z83.20/CSA 2.34.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of radiant heaters.
- B. Examine roughing-in for radiant heaters to verify actual locations of piping and duct connections before equipment installation.
- C. Examine walls/roofs for suitable conditions where radiant heater vents may be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 GENERAL INSTALLATION

- A. Installation of radiant heaters shall be in accordance with all applicable codes shown in the instructions and/or the local codes and authorities having jurisdiction.
 - 1. If necessary contact the local Building Inspector and/or Fire Marshal for guidance.
- B. Heaters shall be installed by a licensed contractor or licensed installer.
Maintain minimum clearances to combustibles as outlined in manufacturer's installation manual. In areas used for storage of combustible materials stacked below the heater, NFPA54 requires that the installer post signs that specify the maximum permissible stacking height to maintain the required clearances from the heater to combustibles.
 - 1. Ensure there is adequate air circulation around the heater and that supply air for combustion, ventilation and distribution is in accordance with all regulatory requirements.
 - 2. If a heater will be installed in a high altitude area (above 2,000'), arrange for the manufacturer to design and fabricate the unit to meet the altitude requirements.
 - 3. Every heater shall be located with respect to building construction and other equipment so as to permit access to the heater.
 - 4. The installer shall consider combustible materials, vehicles parked below, lights, overhead doors, storage areas with stacked materials, sprinkler heads, gas and electrical lines and any other possible obstructions or hazards prior to placement of the unit. Consideration also must be given to service accessibility.
 - a. Plan location of fasteners and supports and ensure that manufacturer's support load requirements are met.
- C. Install wind and seismic restraints according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roof-curb rails are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.2 VENTING

- A. The venting must be installed in accordance with manufacturer's requirements and the following codes:
 - 1. Latest edition of the National Fuel Gas Code (ANSI Z223.1–latest edition) or the authority having jurisdiction.
- B. Un-insulated single-wall metal pipe shall not be used.
- C. In regions of the country where prevailing winds are consistently higher than 40 mph, it may be necessary to terminate the vent system above the roof level. Other venting references can be found in equipment volume of the ASHRAE Handbook.
 - 1. When venting the heater to outside of building through a roof, use 4 inch I.D. double walled insulated metal pipe. This is to be constructed of galvanized sheet metal or other approved noncombustible corrosion-resistant material as allowed by state or local codes.
 - 2. A vent passing through a combustible roof shall extend through a 2-inch clearance roof thimble.
- D. A manufacturer approved vent cap must be attached to end of the flue.
- E. The size and length of vent pipe should be meet manufacturer and regulatory requirements.
- F. Avoid locating elbows in the first 5 ft. of vent pipe whenever possible. Limit the quantity of 90° elbows to two (2).
- G. Horizontal vent piping must have 1/4 inch per foot rise.
- H. Joints between sections of piping shall be fastened by sheet metal screws or other approved means and should be sealed to prevent leakage of flue gas into building. Refer to Division 23 Metal Ducts.
- I. All portions of the vent pipe shall be supported to prevent from sagging. Refer to Division 23 Hangers and Supports for HVAC Piping and Equipment.

- J. When the vent pipe passes through areas where the ambient temperature is likely to induce condensation of the flue gases, the vent pipe should be insulated and a condensation drain should be provided.
- K. Venting system shall terminate at least 3 ft. (0.9m) above any forced air inlet located within 10 ft. (3.1m).
- L. For pitched roofs, the vent shall terminate above the roof line so that no discharge opening is less than 2 feet (0.6m) horizontally from the roof surface. Consult manufacturer and regulatory requirements.
- M. When venting the heater horizontally through a combustible outside sidewall, the same requirements listed previously for venting vertical through the roof apply except as follows:
 - 1. The horizontal venting system shall not terminate:
 - a. Less than 4 ft. (1.2m) below, 4 ft. (1.2m) horizontally from, or 1 ft. (30cm) above any door, window or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 7 ft. (2.1m) above grade or above snow accumulation level as determined by local codes.
 - b. Less than 3 ft. (0.9m) from a combustion air inlet.
 - c. Less than 3 ft. (0.9m) from any other building opening or any gas service regulator.
 - d. Directly over areas where condensate or vapor could create a nuisance or hazard or be harmful to the operation of gas utility meters, regulators, relief valves, or other equipment. Building materials should be protected from flue gases and condensate.
- N. Common venting of multiple heaters in confined spaces is prohibited.
- O. Follow manufacturer and regulatory requirements for provision of combustible and outside make-up air.

3.3 CONNECTIONS

- A. The heater must be electrically grounded in accordance with the following codes:
 - 1. National Electrical Code®,
 - 2. NFPA 70 - latest revision. Wiring must conform
 - 3. CSA C22.1 Part 1 - latest revision.
 - 4. Locality where the installation is made.
- B. The wiring providing power to the heater shall be connected to a designated breaker.
- C. A fused disconnect may be required by local codes and shall be located in the vicinity of the heater (check local codes for allowable distances) and should be identified as Heater Service Switch.
- D. All electrical wiring must be located in accordance with the required clearances to combustibles below the heater as listed on the nameplate on the heater.
- E. When connecting the supply circuit to the heater, wiring material having a minimum size of 14 AWG and a temperature rating of at least 90°C shall be used.
- G. Connect gas supply in accordance with the latest edition of National Fuel Gas Code (ANSI Z223.1) and local building codes.
- F. All gas supply lines must be located in accordance with the required clearances to combustibles.
- G. Pipe joint compounds must be resistant to the action of liquefied petroleum gases.
- H. Where local codes do not prohibit, install a CSA or U.L. approved flexible connector (minimum 5/8" I.D.) between the rigid piping and the heater. A union and an approved shut off valve shall be installed before the control valve inlet. The shut off valve shall be installed within 6 feet of the union.
- I. After all gas connections have been made, make sure the heater and all gas outlets are turned off before the main gas supply is turned on. Turn the gas pressure on and check for leaks utilizing a soap suds solution and apply at all connections and joints.

3.4 TESTING AND ADJUSTMENT

- A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit housing.
 - 2. Inspect for visible damage to burner.
 - 3. Inspect internal components.
 - 4. Verify that labels are clearly visible.
 - 5. Verify that clearances have been provided for servicing.
 - 6. Verify that controls are connected and operable.
 - 7. Inspect flue and clean of any construction debris.
 - 8. Connect and purge gas line.
 - 9. Inspect operation of ventilation.
 - 10. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 11. Operate unit for an initial period as recommended or required by manufacturer.
 - 12. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
 - a. Measure gas pressure to ensure supply meets design requirements.
 - b. Inspect operation of power vents if applicable.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at discharge.
 - e. Perform flue-gas analysis. Measure and record the flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 - 13. Calibrate thermostat/s.
 - 14. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

SECTION 26050 – BASIC ELECTRICAL REQUIREMENTS**PART - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 DRAWINGS AND SPECIFICATIONS

- A. All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.
- B. Drawings are diagrammatic and indicate the general arrangement of equipment and wiring. Most direct routing of conduits and wiring is not assured. Exact requirements shall be governed by architectural, structural and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull or junction boxes, etc., necessitated by such conditions shall be included in the bid. Check all information and report any apparent discrepancies before submitting bid.
- C. Should there be any discrepancies or a question of intent, refer the matter to the Owner for a decision before ordering any equipment, materials or before starting any related work.

1.2 DEFINITIONS

- A. Above Grade: Not buried in ground or embedded in concrete slab on grade.
- B. Below Grade: Buried in ground or embedded in concrete slab.
- C. Concealed: Inside building above grade and located within walls, furred spaces, crawl spaces, attics, above suspended ceilings, etc. This refers to any item not visible or directly accessible.
- D. Connect: Complete hookup of item with required services, including conduit, wires and other accessories.
- E. Exposed: Either visible or subject to mechanical or weather damage, indoors or outdoors, including areas such as mechanical and storage rooms. In general any item that is directly accessible without removing panels, walls, ceilings, or other parts of structure.
- F. Furnish: Supply and deliver complete.
- G. Install: Place, secure and connect as required to make fully operational (Perform work).
- H. Provide: See furnish above.
- I. Underground: Buried in ground, including under building slabs
- J. Use (verb): Furnish and install as defined above.
- K. Wiring: Electrical raceway, conductors and connection.

1.3 QUALITY ASSURANCE

- A. Carefully examine the contract documents, visit the site, and thoroughly become familiar with the local conditions relating to the work. Failure to do so will not relieve the contractor of the obligations of the Contract.
- B. After all equipment, devices and raceways are installed and wires and cables are in place and connected to devices and equipment, test the system for continuity, proper phase rotation, short circuit, improper grounds, polarity and other defects. If defective condition is present, make all necessary corrections and retest for compliance. Test systems for proper operation and demonstrate the operation of the system to the Owner's Representative

1.4 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

1.5 WORKMANSHIP AND INSTALLER'S QUALIFICATIONS

- A. Electrical installation shall be completed by licensed electricians, from an electrical contracting firm with at least five years of successful electrical installation experience on projects utilizing electrical components similar to those in both size and type, to those required for this project. All specialties, including computer isolated ground/ dedicated circuit power, and low voltage wiring installations shall be performed by an electrician qualified in the maintenance and installation of such systems.

1.6 SCOPE OF WORK

- A. Furnish, erect, install, connect, clean, adjust, test, condition and place into service all material and equipment in accordance with the manufacturer's directions and recommendations except as otherwise noted and provide all labor required to complete

- the work shown on the drawings and/or specified in all Sections of Division 26 and all other work and miscellaneous items, not specifically mentioned, for a complete installation including all accessories required for testing the system. Such that the system is complete, code compliant and ready for operation.
- B. Apparatus, appliance, material or work not shown on drawings, but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and ready for operation, even though not specified or shown on the drawings, shall be furnished and installed without additional expense to the Owner.
 - C. Delivery and Storage: Receive, handle, and store electrical items and materials at the project site. Materials and electrical items shall be so placed that they are protected from damage, weather, environmental factors and deterioration.
 - D. Secure and pay for all permits, governmental fees, taxes and licenses necessary for the proper execution and completion of Division 26 work.
 - E. Submit to governmental agencies and utility companies shop drawings, cutsheets, calculations, or installation drawings for the emergency lighting and exit sign system, life safety/fire alarm system, or any other system or installation element that are required by these agencies, for their approval.
 - F. Maintenance Manuals: Submit two copies of maintenance manuals in hard bound covers containing shop drawings and manufacturers' repair manuals, guarantees, operating instructions, wiring diagrams and parts lists to Owner.
 - G. Instruction Manuals: Submit two complete instruction manuals for any specialty system installed to Owner.
 - H. Field Record Drawings: Submit field record drawings for the work in accordance with the General Conditions to Owner.

1.7 CODE COMPLIANCE

- A. Comply with NFPA 70.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. All OSHA and safety code requirements.
- D. Materials and installation shall comply with codes, laws and ordinances of Federal, State, local governing bodies having jurisdiction.
- E. In every installation where regulations of electric utility and telephone companies apply, conformance with their regulations is mandatory and any costs involved shall be included in the Contract.
- F. In case of differences between building codes, State and Federal laws, local ordinances and utility company regulations and the Contract Documents, the most stringent shall govern.

- G. In case of differences between means, materials, or methods indicated in these specifications and those indicated in the construction documents, the more stringent shall govern.
- H. Should work be performed which does not comply with the requirements of the applicable building codes, State and Federal laws, local ordinances, industry standards and utility company regulations, changes for compliance shall be done at no additional cost to the Owner.
- I. Notify the Owner of any materials or apparatus believed to be inadequate, unsuitable, in violation of laws, ordinances, rules or regulations of authorities having jurisdiction.

1.8 WARRANTY

- A. General Warranty: This special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents."

PART 2- PRODUCTS

2.0 MATERIALS AND EQUIPMENT

- A. Materials, equipment and accessories shall be new, UL listed and labeled as defined in NFPA 70 article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use, and shall bear the manufacturer's name, model number and other identification marking.
- B. Materials and equipment shall be the standard product of a manufacturer regularly engaged in the production of the required type of material or equipment for at least five years (unless specifically exempted by the Owner) and shall be the manufacturer's latest design with published properties.
- C. Equipment and materials of the same general type shall be of the same manufacture throughout the project to provide uniform appearance, operation and maintenance.
- D. Equipment and materials shall be without blemish or defect and shall not be used for temporary light or power purposes, including lamps, without the Owner Representative's written authorization.

2.1 ALTERNATE PRODUCTS

- A. Alternate Materials, fixtures, apparatus or equipment installed without written approval shall be removed by the Contractor and replaced with specified equipment at the direction of the Owner Representative and without recourse for additional compensation.
- B. Acceptance of alternates shall include provisions necessary to alter, adjust or otherwise modify work affected by the alteration.

- C. Field record drawings shall include alternate work and shall reflect changes necessitated to other work.

PART 3- EXECUTION

3.0 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. All listed materials and equipment shall be installed in accordance with their listing.
- B. The drawings for work under Division 26 are diagrammatic and are intended to convey the scope of work and indicate the general arrangement of conduit, boxes, equipment, fixtures and other work included in the Contract.
- C. Location of items required by the drawings or specifications not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to the approval of the Owner's Representative.
- D. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points:
 - 1. Where headroom or space conditions appear inadequate, the Owner's Representative shall be notified before proceeding with installation.
 - 2. Minor conduit rerouting and changes shall be made at no additional cost to the Owner.
 - 3. Coordinate the mounting heights of electrical equipment and raceways to clear the opening heights of doors, the heights of vehicles (cars, trucks) and the heights of equipment which needs to be removed and replaced.
- E. Perform all work with skilled mechanics of the particular trade involved in a neat and workmanlike manner.
- F. Perform all work in cooperation with other trades and the construction schedule.
- G. Furnish other trades advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, and also furnish information and shop drawings necessary to permit trades affected to install their work properly and without delay.
- H. Where there is evidence that work of one trade will interfere with the work of other trades, all trades shall assist in working out space allocations to make satisfactory adjustments.
- I. With the approval of the Owner's Representative and without additional cost to the Owner, make minor modifications in the work as required by structural interferences, by interferences with work of other trades or for proper execution of the work.
- J. Work installed before coordinating with other trades so as to cause interference with the work of such other trades shall be changed to correct such condition without additional cost to the Owner and as directed by the Owner's Representative.
- K. Minor changes in the locations of outlets, fixtures and equipment shall be made prior to rough-in at the direction of the Owner's Representative and at no additional cost to the Owner.

- L. Electrical Contractor shall cooperate with other trades and coordinate work so that conflicts with other work are eliminated.
- M. Equipment shall be installed with adequate space allowed for removal, repair or changes to equipment. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment that is to be installed or which is in place. Electrical Contractor shall verify measurements. Discrepancies shall be brought to the Owner's Representative's attention for interpretation.
- N. Determine temporary openings in the buildings that will be required for the admission of apparatus furnished under this Division, and notify the Owner's Representative accordingly. In the event of failure to give sufficient notice in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.
- O. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- P. No work shall be concealed until after inspection and approval by proper authorities. If work is concealed without inspection and approval, the contractor shall be responsible for all work and costs required to open and restore the concealed areas in addition to all required modifications.
- Q. Electrical Contractor shall refer to contract documents for details, reflected ceiling plans, and large scale drawings; will also verify any conflicts between various trades.
- R. Verify all dimensions by field measurements.
- S. Coordinate connection/shut-off and disconnection of electrical service with exterior underground and overhead utilities and services. Also coordinate with owner and utility. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
- T. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- U. Install access panel or doors where units are concealed behind finished surfaces.
- V. Verifications of Points of Connection:
 - 1. Before submitting his bid, Contractor shall visit site and contact city, owner and all utilities to verify location, size, depth and operating characteristics of points of connection.
 - 2. If Contractor fails to notify Owner in writing, it will be assumed that his bid includes everything required to provide proper connections to all present points of connection as they actually exist or as they will be provided by city or utilities, and will pay for all utility point of connection modifications, relocations, replacements, additional runs and extensions, without increase in contract price.
 - 3. Electrical Contractor shall furnish all labor, material and equipment to completely install all work shown on drawings and specified herein, including:
 - a. Installation of and final connections within HVAC control system supplied by others.
 - b. Connection to mechanical equipment: HVAC power conductors and proper grounding conductors for HVAC equipment.
 - c. Final connections to kitchen equipment.
 - d. Complete and operable Telephone System.

- e. Complete and operable Cable TV system as required.
- f. Complete and operable Internet system as required

3.1 COOPERATION

- A. Where jurisdictional rules require the assistance of electrical mechanics in the moving and setting of electrically powered equipment, provide such assistance.
- B. Where work covered by this section connects to equipment furnished under other sections, verify electrical work involved in the field and make proper connection to such equipment.

3.2 ALTERATIONS AND DEMOLITION

- A. Confer with the manufacturers of existing equipment that is to be revised or extended.
- B. Where existing electrical work prevents proper construction of new work as indicated, remove, reroute, relocate, or in other ways alter existing work in order to accommodate new work requirements.
- C. Remove suspended acoustical ceiling tiles necessary to facilitate the installation of the electrical work and restore the ceiling tiles after completion of the electrical work. Replace ceiling tiles damaged during the work with new tiles to match the existing in every respect.
- D. Where existing conduit, wire, supports, hangers, and other electrical work must be removed as a result of the alterations, they shall be completely removed, back to the first outlet which is left unaffected by the revision. Conduit which is buried in concrete or otherwise inaccessibly positioned may be abandoned. In such cases, wire shall be pulled out of conduit and the conduit itself plugged at each end.
- E. Existing electrical materials and equipment, including lighting fixtures, switches, receptacles, signal lights, speakers, intercom equipment, controls, conduit outlets, fittings, wire, cable, and other devices which are removed as a result of the alterations are the property of the Owner. Check with Owner to determine what is to be salvaged.
- F. Existing electrical materials and equipment with the exception of wire and cable, as generally outlined in the previous paragraph, shall be re-used as completely as is found practicable. Examine the condition of such materials and equipment and make a prior determination of whether it is suitable for re-use. Present findings periodically to the Owner's Representative who in turn will make the final decision regarding re-usability. All wire and cable shall be new.
- G. In order to coordinate the work of the mechanical and electrical trades, completely remove all existing electrical work in and above ceilings of these areas (as defined on the Drawings), after which install new work and re-install existing work to remain, as shown on the Drawings. Existing lighting fixtures, time-clocks, speakers, signals, and other equipment shall be re-used except as otherwise noted. If fixtures must be utilized in areas with new ceiling tile, make arrangements for cutting new tile to accommodate fixtures. Some exceptions may arise wherein equipment, either in altered areas or other areas, must be kept in service, requiring that feeders, signal conductors, conduits, boxes, etc. serving same also be kept in service. In such cases, those electrical feeders, signal conductors, conduits, etc. shall be re-routed and re-connected before present work is removed. If this is not possible, temporary wiring shall be provided to allow for installation

of mechanical work, after which new work shall be installed and temporary wiring removed.

- H. Various signal, communications, and other services shall remain in service to provide continuous operation for the Owner's functions. No interruption of any service will be allowed without written approval from the Owner.
- I. Remove or reroute all electrical feeders, risers, branch circuits, and other wiring as required by the alterations. Wiring extending through remodeled areas but serving loads which must remain shall be rerouted as required, and reconnected to those loads.

3.3 EXCAVATING AND BACKFILLING

- A. Excavating, bracing and shoring, testing, disposition of excess excavated material, provision of borrow, and placing of backfill shall be in accordance with Section Excavating and Backfilling.

3.4 CUTTING AND PATCHING

- A. Do drilling, cutting, fitting, and patching necessary for the installation of conduits, wireways, and other electrical equipment, and provide supports necessary for the same and for bracing and anchorage of work. No cutting of structural work or of fireproofing shall be done without the written consent of the Owner.
- B. Conduits passing through roofs or other surfaces exposed to weather shall be properly flashed as specified in roofing and waterproofing sections. This flashing work shall be part of this division of work.

3.5 CLEAN UP

- A. The Contractor shall, at all times, keep the premises free from the accumulation of waste materials or rubbish caused by his work and, at the completion of the work, shall remove his rubbish, tools, equipment and surplus materials; and shall leave his work clean and ready for use.

3.6 EQUIPMENT NOISE LIMITATION

- A. Noise levels of electrical devices and equipment shall be within acceptable limits as established by NEMA or other valid noise rating agencies. Noise levels shall be subject to the Owner's Representative, based on practical and reasonable considerations of occupancy requirements.
- B. Check and tighten the fastenings of sheet metal plates, covers, doors, trims, bus bars and all electrical connections to prevent vibration and chatter under normal conditions of use.
- C. Transformers, reactors, dimmers, lamp ballasts, and solenoids shall be designed and rated for "quiet" operation.
- D. Remove and replace any individual electrical item or device that is found to produce a sound energy output exceeding that of other identical devices installed at the project.

3.7 TRANSMISSION OF VIBRATION

- A. Electrical equipment, conduit, and fittings shall not be mounted to or supported by elements subject to vibration except by methods which will prevent transmission thereof. Where flexible lengths of conduit are utilized as a means of isolating equipment and conduit systems vibration, care shall be exercised to assure continuity of ground throughout.

3.8 MOUNTING HEIGHTS

- A. Mounting heights of electrical items shall be as listed on the drawings, unless otherwise required by local code requirements, the Americans with Disabilities Act, or by the Owner's Representative's field instructions. Dimensions are above finished floor, unless otherwise indicated.
- B. No switch, circuit breaker, fuse handle, disconnect or other similar device shall be mounted so that it is higher than 6'-7" AFF or working platform to comply with the readily accessible requirements of the code.

3.9 PROTECTION

- A. Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps. Cover fixtures, materials, equipment and devices furnished or installed under this section or otherwise protect against damage, both before and after installation. Fixtures, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced.
- B. Equipment shall be inherently safe and moving parts shall be covered with guards.

3.10 TEMPORARY UTILITIES, LIGHTING AND HEAT

- A. Contractor's attention is directed to Division 01, which sets forth respective responsibilities of all concerned with furnishing temporary water, electricity, lighting and heat for use during construction of the Project.

3.11 EXECUTION, CORRELATION AND INTENT OF DOCUMENTS

- A. In the event that conflicts, if any, cannot be settled promptly and amicably between the affected trades, with work proceeding in a workmanlike manner, then the Owner's Representative shall decide which work is to be relocated and their judgment shall be final and binding on this Contractor.

3.12 INSTRUCTIONS AND ADJUSTMENT

- A. The primary adjustments and operational instructions of the system(s) shall be accomplished by the Contractor to the complete satisfaction of the Owner at the time of completion of the installation.

SECTION 26051 – BASIC ELECTRICAL MATERIALS AND METHODS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Anchors, sleeves, inserts, hangers and supports.
 - 3. Access Panels
 - 4. Electrical identification.
 - 5. Electricity-metering components.
 - 6. Concrete equipment bases.
 - 7. Vibration isolation
 - 8. Electrical demolition.
 - 9. Cutting and patching for electrical construction.
 - 10. Touch-up painting.

1.2 QUALITY ASSURANCE

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

1.3 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS**2.0 ANCHORS, SLEEVES, INSERTS, HANGERS AND SUPPORTS**

- A. Anchor bolts, sleeves, inserts, hangers and supports required for the Electrical work shall be furnished and installed under Division 26.
- B. See Division 05 "Metal Fabrications" for additional requirements.
- C. Hangers and Supports:
 - 1. Provide hangers, angles, channels, and other supports required by field conditions to install items of electrical equipment. Design of supports and methods of fastening to building structure shall be acceptable to the Owner's Architect and acceptable to authorities having jurisdiction. Provide spring hangers for vertical raceway supports.
 - 2. No electrical items shall rest on, or depend for support on, suspended ceiling media (tiles, lath, plaster, splines, etc).
 - 3. In suspended ceilings, support conduits directly from structural slabs, decks (or framing members). Do not support conduits on ceiling suspension members.
 - 4. Support surface or pendant lighting fixture:
 - a. From an outlet box by means of an interposed metal strap, where weight is less than 5 lbs.
 - b. From an outlet box by means of a hickey or other direct threaded connection, where weight is from 5 to 50 lb.
 - c. Directly from structural slab, deck or framing member, where weight exceeds 50 lbs.
 - 5. In addition to the above, provide cushioned, swivel type hangers with appropriate outlet boxes for pendant fixtures in mechanical areas. Such hangers shall have a support rating at least twice that of the load supported.
 - 6. Provide weight-distribution facilities, where required so as not to exceed the load-bearing capabilities of floors or walls that bear the weight of, or support, electrical items.
 - 7. Hangers and supports shall be hot dipped galvanized, unless noted otherwise.
 - 8. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.
 - 9. Trapeze type hangers may be used where several conduits are to be installed at the same elevation. The spacing of such trapeze hangers shall be in accordance with the NEC for the smallest conduit in the run.
- D. Sleeves and Openings:
 - 1. Provide sleeves and wireways where they pass through walls or floors.
 - 2. Sleeves shall be not less than 1" larger than outside dimension of raceways.
 - 3. Floor sleeves shall be galvanized steel pipe or plastic, as approved by code and stubbed 3" above floor. Unused sleeves shall be capped.
 - 4. Provide 3" high concrete curbs around openings through floors.
 - 5. Sleeves through kitchen or storage areas, and customer dining or other similar quiet area shall have the net openings packed with glass fiber insulation and both ends of sleeve caulked with waterproof mastic to prevent noise, dirt, air and water transmission. The utility companies shall pack the inside of their sleeves.
 - 6. Where conduits pass through floors or exterior walls, caulk sleeves with appropriate sealant at both ends to insure waterproofing around pipe.
 - 7. Where conduits pass through foundation walls, provide entrance seals.
 - 8. After the completed work is in place pack or fill sleeves and openings to prevent leakage of liquid and the spread of fire and smoke.
 - 9. Fire rated walls/floors shall be firestopped to match rating of original construction. Materials and methods shall comply with Underwriters Laboratories Directory "Fire Resistance - Vol. 1 and Vol. 11".
- E. Inserts:
 - 1. Inserts for suspended items in poured concrete construction shall be malleable-iron concrete inserts, adjustable type with insert nut.
 - 2. Inserts for surface mounted items shall be suitable for the composition of the slab, wall, or structure on which installation is to be made.
- F. Cable supports shall be compatible with wire and cable type and conduit size.

2.1 CABLE LUBRICANT

- A. The lubricant shall contain no waxes, greases, silicones or polyalkylene glycol oils or waxes.
- B. The lubricant shall have less than 6% solids residue after drying for 24 hours at 105°C.

2.2 CONDUCTIVE COMPOUNDS

- A. Copper base anti-corrosive conductive compound for conduit connections in earth or concrete in contact with earth.

2.3 ACCESS PANELS

- A. Panels shall be flangeless hinged type with vandal proof fasteners.

2.4 IDENTIFICATION OF ELECTRICAL ITEMS

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size:
 - 1. Type: Pre-tensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
 - 2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is over-laminated with a clear, weather- and chemical-resistant coating.
 - 3. Color: Black letters on orange background.
 - 4. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
- D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend that indicates type of underground line.
- E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Use colors to suit coding scheme.
- G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Use black engraved letters on white background.
- H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Use weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch, galvanized-steel backing, with colors, legend, and size appropriate to the application. Provide 1/4-inch grommets in corners for mounting.
- J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company. Enclosure: NEMA Type 3R.
- B. Meter Sockets: Comply with requirements of electrical power utility company.
- C. Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses.
 - 1. Housing: NEMA 250, Enclosure: Indoor: Type 1, Outdoor: Type 3R.
 - 2. Tenant Branch Circuit Breakers: Series combination rated to protect circuit breakers in downstream panelboards that have 10,000-A interrupting capacity, minimum.

2.6 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 03 "Cast-in-Place Concrete."

2.7 VIBRATION ISOLATION

- A. Suspended vibration producing equipment shall have spring elements in the hanger rods or isolation pads under the equipment.

2.8 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Different / Additional requirements will be necessary in areas requiring seismic restraints for electrical equipment and components. See Division 26 "Vibration and Seismic Controls for Electrical Systems".

3.1 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system component.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.2 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Raceway Supports shall comply with NFPA 70, other applicable codes, and manufacturer's requirements.
- C. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- D. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

- E. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- F. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- G. Install 1/4-inch (6-mm) diameter or larger threaded steel hanger rods, unless otherwise indicated.
- H. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- I. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- J. Simultaneously install vertical conductor supports with conductors.
- K. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- L. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- M. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- N. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete if approved by the authority having jurisdiction.
 - 6. Steel: Welded threaded studs or spring-tension clamps on steel:
 - a. Field Welding: Comply with AWS D1.1.
 - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 8. Light Steel: Sheet-metal screws.
 - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.3 INSTALLATION OF ACCESS PANELS

- A. Where items such as pull boxes, junction boxes, other specialties, or any piece of equipment or device requiring adjustment or service, are concealed in the construction, furnish an access panel for ceilings or walls to permit adjustment or service of concealed item. Design to be suitable for installation in the material forming the finished surface in which panel is mounted.

3.4 INSTALLATION OF EXPANSION FITTINGS

- A. At each building expansion joint and in each straight uninterrupted run of surface mounted conduit and vertical risers in excess of 100' an appropriate expansion fitting shall be provided, and the distance between fittings as installed shall not exceed 100 linear feet.

3.5 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.6 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 07 "Penetration Firestopping."

3.7 CONCRETE BASES

- A. The Contractor shall provide concrete pedestals, bases, pads, curbs, anchor blocks, anchor bolts, slab inserts, hangers, channels, cradles, saddles, etc. for installation of equipment and apparatus.
- B. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.8 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing fireproofing has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work. Repair or replace as necessary; including the following:
 - 1. Raceways.
 - 2. Wire and Cable-600 Volt.

3. Supporting devices for electrical components.
4. Anchors, sleeves, inserts, hangers and supports.
5. Contractors
6. Lighting Contractors-Multiple Poles.
7. Metallic Conduit and Fittings.
8. Bushings.
9. Conduit Seals.
10. Expansion Fittings.
11. Cable Supports.
12. Cable Lubricant.
13. Conductive Compounds.
14. Cable and Feeder Taps and Splices.
15. Junction and Pullboxes.
16. Outlet Boxes.
17. Non-Metallic Conduit and Fittings-PVC.
18. Manholes.
19. Access Panels.
20. Time Switches and Photo Controls.
21. Wiring Devices.
22. Wiring Devices Plates.
23. Electrical Identification.
24. Electricity-Metering Components.
25. Concrete Equipment Bases.
26. Vibration Isolation.
27. Electrical Demolition.
28. Cutting and Patching for Electrical Construction.
29. Touchup Painting.

3.11 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 09 "Painting":
 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.12 CLEANING CONDUITS AND DUCTS

- A. After conduits (ducts) and accessories have been installed, and concreting operations are completed, conduit runs shall be satisfactorily cleared of obstructions and foreign matter. Defects which might damage cable upon installation shall be corrected. Where conduits (ducts) installed are connected to conduits (ducts) installed by others, the entire run to the nearest box, manhole, or other termination point shall be cleaned. Clearing and cleaning shall be done by pulling through each conduit (duct) a flexible cylindrical mandrel having an outside diameter 1/4" less than the inside diameter of the conduit (duct). Defects and stoppages occurring in portions of the conduit (duct) run shall be corrected.

3.13 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

SECTION 26052 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other sections.
- B. Applications of electrical grounding and bonding work to be furnished and installed by the contractor in this section shall include, but not be limited to the following (as a minimum):
 - 1. Underground metal water piping electrode.
 - 2. Ground rod electrode.
 - 3. Concrete encased electrodes.
 - 4. Metal building frame electrodes.
 - 5. Electrical power systems.
 - 6. Other grounding electrodes.
 - 7. Isolated grounding.
 - 8. Telephone equipment.
 - 9. CCTV equipment.
 - 10. CATV equipment.
 - 11. Security equipment.
 - 12. Gas piping bonding.
 - 13. HVAC ductwork bonding.
 - 14. Raceways.
 - 15. Service equipment.
 - 16. Enclosures.
 - 17. Equipment.
 - 18. Lighting standards.
 - 19. Landscape lighting.
 - 20. Signs.

1.2 SUBMITTALS

- A. Submit detailed drawings, calculations, and/or test results to the authorities having jurisdiction where required for approval, showing all grounding details, grounding installation and material specifications. The work shall not proceed until this approval has been obtained.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Electrical System grounding and individual equipment grounding shall in all instances conform to the minimum requirements of NFPA 70, The National Electric Code, local codes or regulations, and regulations of the serving utilities, except where McDonald's corporate standards exceed those minimum requirements.
- D. Comply with latest NFPA 70.

PART 2 - PRODUCTS**2.0 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Grounding Conductors:
 - 1. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
 - 2. Material: Copper.
 - 3. Equipment Grounding Conductors: 600 Volt Insulated copper with green-colored insulation.
 - 4. Isolated Ground Conductors: 600 Volt Insulated copper with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
 - 5. Grounding Electrode Conductors: 600 Volt stranded copper insulated conductors.
 - 6. Feeder Grounding Conductors: 600 Volt stranded copper insulated conductors, unless otherwise indicated.
 - 7. Copper Bonding Conductors: As follows:
 - a. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor, unless otherwise indicated.
 - b. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inches thick.
 - 8. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.1 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.2 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel 5/8 in diameter by 96 inches long.
- B. Concrete encased ground (Ufer).

PART 3 - EXECUTION**3.0 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods: Bolted connectors.
4. Connections to Structural Steel: Bolted or Welded connectors.

3.1 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.2 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install insulated equipment grounding conductors with all feeders and branch circuits.
- C. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Metal-clad cable runs.
 8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- F. Technology/POS Isolated Ground/Dedicated Circuits: Install insulated equipment grounding conductor (green) and an insulated isolated grounding conductor (green with yellow strip) in a separate dedicated branch-circuit conduit run from subpanel to the junction box containing the isolated ground receptacle serving said equipment. Bond one end of the equipment grounding conductor (green) at the ground bus in source subpanel and the other to the junction box housing the isolated ground receptacle. Bond the isolated grounding conductor to the isolated ground bus in the source subpanel and the other to the isolated ground receptacle's isolated ground terminal.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 1. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

- H. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors. Metal pole, grounding electrode, and equipment grounding conductor shall be bonded together to form a common ground point at the grounding lug of metal pole.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least two rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting or water meter is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding system at service entrance.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports for the following:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner's Representative promptly and include recommendations to reduce ground resistance.

SECTION 26053 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. RNC: Rigid nonmetallic conduit.
- G. RMC: Rigid metal conduit.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. The following wiring methods SHALL NOT be used: Non-Metallic sheathed cable (Romex, NM, NMC and NMS), Armored Cable Type AC (BX), Electrical Non-Metallic Tubing, Type ENT (Smurf-Tube).

1.4 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system and partition assemblies.

PART 2 - PRODUCTS**2.0 GENERAL**

- A. Provide conduit and fittings of types, grades sizes and wall thickness for each service indicated. Where types and grades are not indicated, provide proper selection to fulfill wiring requirements listed within this specification and to comply with the applicable portions of the NEC and local, state and federal codes for raceways and installations.
- B. Provide complete raceway systems and enclosures for all wiring throughout the extent of the systems specified.

2.1 METAL CONDUIT AND FITTINGS

- A. RMC: Provide rigid steel, zinc coated, threaded type conforming to ANSI C80.1 and UL6.

- B. IMC: Rigid intermediate grade hot-dip galvanized, threaded type conforming to ANSI C80.6 and UL124Z.
- C. EMT and Fittings: Zinc coated steel conforming to ANSI C80.3 and UL 797.
 - 1. Fittings: Set-screw or compression type by application and requirements listed in raceway application section. Indenter type and cast fittings shall not be utilized.
- D. FMC: Formed from continuous length of spirally wound, interlocked zinc-coated steel conforming to UL1.
- E. LFMC: Constructed with single strip, flexible, continuous, interlocked and double wrapped flexible steel; galvanized inside and outside; coated with liquid tight jacket of flexible polyvinyl chloride (PVC) sunlight and UV resistant.
- F. Fittings for Conduit (Including all Types and Flexible and Liquid Tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
- G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND FITTINGS

- A. RNC: Heavy wall conduit: NEMA TC 2, Schedule 40 and Schedule 80 PVC, 90° C UL-rated, constructed of polyvinyl chloride and suitable for direct burial use. Sunlight and UV resistant.
- B. RNC Fittings: NEMA TC 3; compatible with conduit type and suitable for use and location.

2.3 METAL WIREWAYS, FITTINGS AND ACCESSORIES

- A. Material and Construction: Sheet metal sized and shaped as indicated; Indoor: NEMA 1 Outdoor: NEMA 3R.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: Hinged type or as indicated in Construction Documents.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
- C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.0 RACEWAY APPLICATION

- A. Outdoors: (for specific applications and appropriate fittings, see table 3.0 this section)
 - 1. Exposed Conduit: RMC, IMC.
 - 2. Concealed: RMC, IMC.
 - 3. Below Grade, Single Run: RNC, RMC.
 - 4. Below Grade, Grouped: RNC, RMC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R or 4.
- B. Indoors: (for specific applications and appropriate fittings, see table 3.0 this section)
 - 1. Exposed Conduit: RMC, IMC.
 - 2. Concealed: EMT, IMC.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
 - 4. Damp or Wet Locations: Rigid steel conduit. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or wet Locations: NEMA 250, Type 4, stainless steel.
- C. Table 3.0 – Application of raceways and fittings, unless otherwise specified.

LOCATION	120/240V / 208V		LOW ENERGY*
EXPOSED			
Lower Level	Per code but not less than 1/2" min. EMT w/ steel set screw couplings		EMT compr. ftgs.
Outdoors	RMC or IMC threaded ftgs.		RMC or IMC threaded ftgs.
CONCEALED			
Walls	Per code but not less than 3/4" min. EMT w/ steel set screw couplings		EMT 1/2" - 2" set screw ftgs
Air Handling Ceiling/Space	Per code but not less than 3/4" min. EMT w/ compr. Fittings		EMT compr. ftgs.
Non Air Handling Ceiling/Space	Per code but not less than 3/4" min. EMT w/ steel set screw couplings		EMT 1/2" - 2" set screw ftgs

BELOW GRADE			
Interior	IMC threaded ftgs. or Schedule 40 or 80 PVC		IMC threaded ftgs. Schedule 40 or 80 PVC
Exterior	Schedule 40 or 80 PVC or RMC threaded ftgs		Schedule 40 or 80 PVC or RMC threaded ftgs

- D. Install low energy conductors in designated conduit and fittings as required by code and authority having jurisdiction.
- E. Type MC cable installations are permitted under the following conditions:
 - 1. Where not exposed to view or subject to physical damage.

3.1 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- C. Do not install aluminum conduits in contact with concrete.
- D. Keep raceways at least 12 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- E. Complete raceway installation before starting conductor installation.
- F. Support raceways as specified in accordance with NFPA 70.
- G. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- H. Install no more than the equivalent of four 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- I. Conceal conduit within finished walls, ceilings, and floors, unless otherwise indicated.
- J. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- N. Raceways for Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Install pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- O. Flexible Conduit Connections: Use maximum of 3' whip of flexible conduit (or MC cable where acceptable) for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors. Installation shall include an integral equipment grounding conductor.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC in damp or wet locations not subject to severe physical damage.

- P. 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.

3.2 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Division 31 Section "Earth Moving."
 - 3. Backfill and compact around conduit following installation. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand-tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 - 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.3 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with fire-stop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.

- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with fire-stop materials.
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work and architectural drawings.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position the raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

SECTION 26054 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Channel support systems.
 - 3. Restraint cables.
 - 4. Hanger rod stiffeners.
 - 5. Anchorage bushings and washers.

1.2 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.3 QUALITY ASSURANCE

- A. Comply with seismic restraint requirements in IBC, BOCA, California Building Code/Code of Regulations of OSHPD, SBC, and UBC, unless requirements in this Section are more stringent.
- B. If location of this electrical installation requires seismic considerations, seismic design and Shop Drawings shall be signed and sealed by a qualified professional or structural engineer.
 - 1. Design Calculations: Calculate requirements for selecting seismic restraints as required.
 - 2. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner): For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
- B. Delegated-Design Submittal (if requested by Owner): For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
 - 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 - 3. Field-fabricated supports.
 - 4. Seismic-Restraint Details:

- a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
- C. Coordination Drawings (if requested by Owner): Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates (if requested by Owner).
- E. Qualification Data (if requested by Owner): For professional engineer and testing agency.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage pre-approval OPA number from OSHPD, pre-approval by ICC-ES, or pre-approval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.0 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with 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; and rated in tension, compression, and torsion forces.
- C. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.
- E. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- F. 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.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with

strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

- I. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.1 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- 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 seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 1. Install restrained isolators on electrical equipment.
 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. 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.
- C. 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.

D. Drilled-in 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 the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed 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 Anchors: 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage as required by Authority having jurisdiction a qualified testing agency to perform tests and inspections and prepare test reports. Submit final reports to Owner.

SECTION 26055 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.2 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS**2.0 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.1 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.2 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with letter and face colors indicated on design documents or as required by code.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Provide white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.4 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.1 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power.
- B. Power-Circuit Conductor Identification, 600 V or Less:
1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White.
 - 5) Ground: Green.
 - 6) Isolation Ground: Green with Yellow Strip.

- c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.
- D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. 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.
- G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer load shedding.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label, or as indicated on drawings. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.

- c. Access doors and panels for concealed electrical items.
- d. Switchgear.
- e. Emergency system boxes and enclosures.
- f. Enclosed switches.
- g. Enclosed circuit breakers.
- h. Enclosed controllers.
- i. Push-button stations.
- j. Power transfer equipment.
- k. Contactors.
- l. Remote-controlled switches, dimmer modules, and control devices.
- m. Battery-inverter units.
- n. Monitoring and control equipment.

SECTION 26092 - LIGHTING CONTROL DEVICES**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following lighting control devices:
1. Time switches.
 2. Outdoor or indoor photoelectric switches.
 3. Indoor occupancy sensors.
 4. Lighting contactors.
- B. Related Sections include the following:
1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated.
- B. Shop Drawings (if requested by Owner): Show installation details for occupancy and light-level sensors.
1. Interconnection diagrams showing field-installed wiring.
- C. Operation and Maintenance Data : For each type of product to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

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

1.5 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system (if applicable), and partitions.

PART 2 - PRODUCTS**2.0 TIME SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis-of-Design Product: Subject to compliance with requirements as shown on Construction Documents.
- B. Electronic Programmable Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: Form-C contacts for normally open and closed circuits.
 - 2. Contact Rating: 20-A ballast load, 120/240-V ac.
 - 3. Programs: channels; each channel shall be individually programmable with 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 - 4. Program: Exterior lighting and signs
 - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
 - 6. Astronomic Time: channels.
 - 7. Battery Backup: For schedules and time clock.
 - 8. Four (4) independently controlled outputs.

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Description: Solid state, with SPDT dry contacts rated for, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 - 1. Light-Level Monitoring Range: 0 to 3500 fc, with an adjustment for turn-on and turn-off levels.
 - 2. Time Delay: 15-second minimum, to prevent false operation.
 - 3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
 - 4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.2 INDOOR PHOTOELECTRIC SWITCHES (if applicable)

- A. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
 - 1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for, and for 1/2 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 - 3. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
 - 5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.3 INDOOR OCCUPANCY SENSORS (if applicable)

- A. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- B. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot high ceiling.
- C. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot high ceiling in a corridor not wider than 14 feet.
- D. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.

2.4 LIGHTING CONTACTORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products as specified on drawings.
- C. Description: Electrically operated and mechanically or electrically held, as defined on Drawings, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.
 - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

PART 3 - EXECUTION

3.0 SENSOR INSTALLATION (if applicable)

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.1 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify intended operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work. Connect deficiencies, make necessary adjustments and retest. Verify that specified requirements are met.

3.5 CLEANING

A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

SECTION 26242 - PANELBOARDS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards rated 600-V and less.
 - 2. Lighting and appliance branch-circuit panelboards rated 600-V and less.
 - 3. Electronic-grade panelboards rated 600-V and less.

1.2 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. GFCI: Ground-Fault Circuit Interrupter.
- C. TVSS: Transient voltage surge suppressor.
- D. RMS: Root Mean Square.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings (if requested by Owner): For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
- C. Qualification Data (if requested by Owner): For qualified testing agency.
- D. Panelboard Schedules (if requested by Owner): For installation in panelboards. Install final versions after load balancing.
- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Obtain panelboards, overcurrent protective devices, components, and accessories from single manufacturer.
- B. 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.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (if required) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.6 PROJECT CONDITIONS

- A. Verify dimensions by field measurements.
- B. Panelboards shall be located to meet or exceed all code clearance requirements.
- C. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- D. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- E. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's approval.
 - 3. Comply with NFPA 70E.

1.7 COORDINATION

- A. 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.

PART 2 - PRODUCTS

2.0 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. When required, fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.

- c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4 or Type 4X, stainless steel.
- 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
- 6. 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: Galvanized steel.
- 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Bus: Tin Plated Aluminum Temp Rated or Copper Temp Rated as required. Provide 750 A per sq. inch Al or 1000 A per sq. inch Cu per local jurisdiction requirements. Bus shall be sequence phased from left to right.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression or Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type.
 - 4. Feed-Through Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 6. Gutter-Tap Lugs: Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating:
 - 1. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating. Circuit breakers in branch panelboards shall have a minimum 10 kAIC rating. Upstream devices shall be rated at 65 kAIC minimum.
 - 2. Clearly and legibly mark on the doors of all panelboards "Caution – Series rated system A. available. Identified replacement components required."
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, as specified on drawings:
- B. Panelboards: NEMA PB 1, power and feeder distribution type.

- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or as specified on drawings.
- E. Branch Overcurrent Protective Devices for all Circuit-Breaker Frame Sizes: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices: Fused switches.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, as specified on drawings:
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating or interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-6-mA trip).
 - 4. Ground-Fault Equipment Protection (GFEF) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 5. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits. Type HACR for heating, air-conditioning and refrigeration equipment.
 - d. Ground-Fault Protection: Integrally mounted or Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
 - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
 - 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

2.3 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, as specified on drawings:
- B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, non-modular type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.

1. Accessories:
 - a. Fuses rated at 200 kA interrupting capacity.
 - b. Integral disconnect switch.
 - c. Redundant suppression circuits.
 - d. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - e. LED indicator lights for power and protection status.
 - f. Audible alarm, with silencing switch, to indicate when protection has failed.
 - g. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
2. Peak Single-Impulse Surge Current Rating: 80 kA per phase.
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
 - a. Line to Neutral: 40,000 A. (minimum)
 - b. Line to Ground: 40,000 A. (minimum)
 - c. Neutral to Ground: 60,000 A. (minimum)
 - d. Line to Line: 80,000 A. (minimum)
4. Protection modes and UL 1449 SVR Second Edition Revision 2.5 Effective February 2007 for grounded wye circuits with 208Y/120-V, three-phase, four-wire circuits shall be as follows:
 - a. Line to Neutral: 330 V for 208Y/120.
 - b. Line to Ground: 330 V for 208Y/120].
 - c. Neutral to Ground: 330 V for 208Y/120.
 - d. Line to Line: 600 V for 208Y/120.
 - e. Mcov: 150 V for 208Y/120.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1., NEC, NECA Standards and Manufacturer's written instructions.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1. Comply with NECA 1.
- B. Equipment Mounting: Install panelboards in location indicated on drawings
 1. Install $\frac{3}{4}$ " thick interior grade fire-retardant-treated plywood on wall area before installing panelboard.
 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with panelboard.
 3. Install suitable anchors through plywood and into wood framing or masonry for proper attachment to panelboards.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
- H. Install filler plates in unused spaces.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads [after balancing panelboard loads]; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.
- C. Panelboards will be considered defective if they do not pass tests and inspections.

3.4 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Project Completion, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

SECTION 26272 - WIRING DEVICES**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Wall-box motion sensors.
 - 4. Isolated-ground receptacles.
 - 5. Wall-switch and exterior occupancy sensors.
 - 6. Communications outlets.
 - 7. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies.

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated.
- B. Shop Drawings (if requested by Owner): List of legends and description of materials and process used for pre-marking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. All devices used shall be UL listed and installed in compliance with its listing.
- E. All wiring devices shall be of specification grade or greater. Residential grade products shall not be utilized.
- F. All wiring devices shall be as specified within the construction documents and/or as contained herein.

PART 2 - PRODUCTS**2.0 RECEPTACLES**

- A. General: Each receptacle shall be constructed to include a grounding pole from which a wired connection to ground shall be provided.
- B. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
 - 1. Receptacles: 15 Amp, 120 Volt NEMA 5-15R, side wired: Hubbell series 5262.
 - 2. Receptacles: 20 Amp, 120 Volt NEMA 5-20R, side wired: Hubbell series 5362.
- C. Locking Receptacles: Heavy-Duty grade, applicable NEMA and UL standards.
- D. GFCI Receptacles (with 4-6mA personnel protection): Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a standard 2-3/4-inch deep outlet box without an adapter.
 - 1. GFCI Receptacles: 15 Amp, 120 Volt, NEMA 5-15R GFCI side wired: Hubbell series GF5252.
 - 2. GFCI Receptacles: 20 Amp, 120 Volt, NEMA 5-20R GFCI side wired: Hubbell series GF5352.
- E. Tamper Resistant GFCI Receptacle: Straight blade, "Safelock" protection.
 - 1. 15 Amp, 120 Volt, NEMA 5-15R, Pass & Seymour series 1595 – TRICC4 (Grey)
 - 2. 20 Amp, 120 Volt, NEMA 5-20R, Pass & Seymour series 2095 – TRI (Grey)
- F. Isolated-Ground Receptacles: Straight blade and twist lock, Heavy-Duty grade, single or duplex receptacle, with isolated equipment grounding conductor connected only to the green grounding screw terminal of the device, with inherent electrical isolation from mounting strap, integral to receptacle construction and not dependent on removable parts.
 - 1. IG Receptacles: 15 Amp, 120 Volt NEMA 5-15R IG simplex, side wired: Hubbell series IG5261.
 - 2. IG Receptacles: 15 Amp, 120 Volt NEMA 5-15R IG duplex, side wired: Hubbell series IG5262 or CR5252IG.
 - 3. IG Receptacles: 20 Amp, 120 Volt NEMA 5-20R IG simplex, side wired: Hubbell series IG5361.
 - 4. IG Receptacles: 20 Amp, 120 Volt NEMA 5-20R IG duplex, side wired: Hubbell series IG5362 or CR5352IG.
 - 5. IG Receptacles (Twist lock): 15 Amp, 120 Volt NEMA L5-15R IG simplex, side wired: Hubbell series IG4710.
 - 6. IG Receptacles: (Twist-lock) 15 Amp, 120 Volt NEMA L5-15R IG duplex, side wired: Hubbell series IG4700A.
- G. Industrial Heavy-Duty Pin and Sleeve Devices: Comply with IEC 309-1.
- H. Enclosures: NEMA 1 unless otherwise noted.

2.1 TOGGLE SWITCHES

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- B. Toggle switches shall be 120-277 Volt, 20 Amp, side wired with grounding connection: Hubbell series HBL1221.
- C. Snap Switches: Heavy-Duty grade, quiet type, UL 20.
- D. Color: Grey

2.2 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch thick, satin-finished type 302 stainless steel, except as otherwise indicated.

3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Outdoor Wet Locations: Provide UL listed and labeled enclosure that is weatherproof whether or not an attachment plug cap is inserted in the receptacle.
5. Plates for Isolated Ground / Dedicated Circuit Receptacles shall be Hubbell PJ8C0 (1 GANG) and PJ82C0 (2 Gang).

2.3 WALL JACKS

- A. Telephone Jack: Compatible for use with phone system and intended use.
- B. Computer Jack: Compatible for use with computer system and intended use.

2.4 FINISHES

- A. Color:
 1. Wiring Devices Connected to Normal Power System: Grey, unless otherwise indicated or required by NFPA 70.
 2. Isolated-Ground Receptacles: Orange or as specified above, with orange triangle on face.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordination with Other Trades:
 1. Take steps to insure that electrical devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pig-tailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
 10. Install all switches in compliance with ADA requirements.
- E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- H. Adjust locations of floor service outlets and service poles if specified to suit arrangement of equipment being served.

3.1 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. When available, connections shall be made to terminal screws of wiring devices in lieu of utilizing spring or compression back-stab type connections. Connections shall be made utilizing solid copper conductors.

3.2 FIELD QUALITY CONTROL

- A. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 5 percent or higher is not acceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

SECTION 26282 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and other Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Non-fusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Obtain enclosed switches and circuit breakers, over-current protective devices, components, and accessories, within same product category, from single source from single manufacturer.
 - 2. Only use approved suppliers.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then

only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner approval.
4. Comply with NFPA 70E.

1.6 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.0 FUSIBLE SWITCHES

- A. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 6. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
 7. Service-Rated Switches: Labeled for use as service equipment.

2.1 NONFUSIBLE SWITCHES

- A. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 4. Hookstick Handle: Allows use of a hookstick to operate the handle.

5. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.

2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products only from approved suppliers.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA). Personnel protection sensitivity or 30-mA trip equipment protection sensitivity, as required by application.
- I. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical or Compression type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.3 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products only from approved suppliers.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
 1. Standard frame sizes and number of poles.
 2. Lugs: Mechanical or Compression type, suitable for number, size, trip ratings, and conductor material.
 3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.

3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4 or Type 4X or stainless steel as required.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.
- F. Install disconnect switches and per local utility requirements. Provide suitable supports.
- G. Install disconnect switches and circuit breakers level and plumb.
- H. Connect disconnect switches and circuit breakers and components to building wiring system and ground as indicated in construction documents and as instructed by manufacturer's installation instructions. Installation shall comply with all requirements of the National Electrical Code.

3.2 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots and burrs. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces, chips, scratches, and abrasions to match original finish.

SECTION 26510 - INTERIOR LIGHTING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multi-pole lighting relays and contactors.

1.2 DEFINITIONS

- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 4. Energy-efficiency data.
 - 5. Life, output, and energy-efficiency data for lamps.
 - 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings (if requested by Owner): Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Power and control wiring.
- C. Coordination Drawings (if requested by Owner): Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Lighting fixtures.
 - 2. Suspended ceiling components.
 - 3. Structural members to which suspension systems for lighting fixtures will be attached.
 - 4. Other items in finished ceiling including the following:

- a. Air outlets and inlets.
- b. Speakers.
- c. Sprinklers.
- d. Smoke and fire detectors.
- e. Occupancy sensors.
- f. Access panels.
- 5. Perimeter moldings.
- D. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system (if applicable), overhead doors, and partition assemblies.

1.6 WARRANTY

- A. General Warranty: This special warranty specified in this Article shall not deprive the Owner of other rights the owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Eight (8) years from date of Substantial Completion. Full Warranty shall apply for first three (3) years, and prorated warranty for the remaining five years.
- C. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One (1) year from date of Substantial Completion.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacture specified.

2.1 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Rated lamp life of **50,000** hours.
- F. Lamps, when dimmable, from 100 percent to 0 percent of maximum light output.
- G. Internal driver.

2.4 EMERGENCY POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924 and NFPA 101.
 - 1. Emergency Connection: Operate LED lamp(s) continuously at an output of 600 – 700 lumens each.
 - 2. Night-Light Connection: Operate all LED lamps continuously.
 - 3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 4. Battery: 1-1/2 Hour Sealed, maintenance-free, nickel-cadmium type with minimum seven (7) year nominal life. Battery shall have a suitable rating and capacity to supply and maintain at not less than 87.5% of the nominal voltage for the lamp load associated with the unit for a period of at least 1-1/2 hours.
 - 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- B. External Type (retrofit applications only): Self-contained, modular, battery-inverter unit, suitable for powering all LED lamps, remote mounted from lighting fixture. Comply with UL 924.
 - 1. Emergency Connection: Operate LED lamp(s) continuously at an output of 600 – 700 lumens each.
 - 2. Night-Light Connection: Operate all LED lamps in a remote fixture continuously.
 - 3. Battery: Sealed, maintenance-free, nickel-cadmium type, with minimum seven year nominal life. Battery shall have a suitable rating and capacity to supply and maintain at not less than 87.5% of the nominal voltage for the lamp load associated with the unit for a period of at least 1-1/2 hours.
 - 4. Charger: Fully automatic, solid-state, constant-current type.
 - 5. Housing: NEMA 250, Type 1 enclosure, plenum rated where required.
 - 6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.7 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
 - 1. Battery: 1-1/2 hour, sealed, maintenance-free, lead-acid type with minimum 10-year normal life and special warranty. Battery shall have a suitable rating and capacity to supply and maintain at not less than 87.5% of the nominal battery voltage for the lamp load associated with the unit for a period of at least 1-1/2 hours.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures as indicated on Drawings.
 - 8. Provide remote head(s), weatherproof for outdoor applications, as indicated on plans.

2.10 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- C. Wires: ASTM A 641, Class 3, soft temper, zinc-coated steel, 12 gage minimum.
- D. Wires for Humid Spaces: ASTM A 580, or A 580 M Composition 302 or 304, annealed stainless steel, 12 gage minimum.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- G. Aircraft Cable Support: Use cable, anchorages and intermediate supports recommended by fixture Manufacturer.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. In seismic areas, install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Lighting Fixture Support:
 - 1. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- E. Furnish and install all lamp or LED module required, including replacements for non-functioning units, until final acceptance of the completed work. No lighting fixture or sign will be installed without lamps or LED modules.
- F. If permanent lighting fixtures are to be used in lieu of temporary lighting facilities during the construction period, this shall be done only as permitted by the Owner who may require that new lamps be installed and fixtures cleaned at the time of turn-over.
- G. Downlight reflectors and parabolic louvers shall be installed in place after the project is completed and dust-free. Installer shall wear white gloves to preclude smudging the reflector surface.
- I. Adjust aimable fixtures to provide required light intensities.
- J. Bond all fixtures to electrical grounding system in accordance with the manufacturer's written instructions and the National Electrical Code.
- K. Install and position emergency lighting unit lamps and remote lamps (as required) to provide foot candle levels required by authority having jurisdiction.
- L. Shielding such as plastic tube shields, plastic sleeves with end caps, shatterproof bulbs and/or other approved devices shall be provided for all artificial lighting fixtures located in areas where a risk of breakage is possible (ie. Less than 8' AFF)
- N. Clean all fixtures after installation. Use methods and materials recommended by manufacturer.

3.1 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.2 CLEANING

- A. Remove all dirt, debris, smudges, etc. from inside and outside of fixture housing as well as lens cover.

SECTION 26560 - EXTERIOR LIGHTING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Poles and accessories.
 - 3. Luminaire lowering devices.

1.2 DEFINITIONS

- A. CRI: Color-rendering index.
- B. HID: High-intensity discharge.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.
- D. Pole: Luminaire support structure, including tower used for large area illumination.
- E. Standard: Same definition as "Pole" above.

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.
 - 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - 6. Photoelectric relays.
 - 7. Ballasts, including energy-efficiency data.
 - 8. Lamps, including life, output, and energy-efficiency data.
 - 9. Materials, dimensions, and finishes of poles.
 - 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 - 11. Anchor bolts for poles.
 - 12. Manufactured pole foundations.
- B. Shop Drawings (if requested by Owner):
 - 1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 - 2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
 - 3. Wiring Diagrams: Power and control wiring.
- C. Pole and Support Component Certificates (if requested by Owner): Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

- D. Qualification Data (if requested by Owner): For agencies providing photometric data for lighting fixtures.
- E. Field quality-control test reports (if requested by Owner).
- F. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.6 WARRANTY

- A. General Warranty: This special warranty specified in this Article shall not deprive the Owner of other rights the owner may have under other provisions of the contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: five years from date of Substantial Completion.
 - 4. Warranty Period for Lamps: Replace lamps and fuses that fail within 24 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 24 months from date of Substantial Completion.
 - 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by approved supplier as shown on drawings.

2.1 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials as indicated on drawings.

2.2 FLUORESCENT BALLASTS AND LAMPS

- A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures minus 20 deg F and higher.
- B. Ballast Characteristics:
 - 1. Power Factor: 90 percent, minimum.
 - 2. Sound Rating: A, except B for T12/HO ballasts.
 - 3. Total Harmonic Distortion Rating: Less than 20 percent.
 - 4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
 - 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
 - 6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.
- C. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36 and hot-dip galvanized according to ASTM A 123; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

PART 3 - EXECUTION

3.0 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming.

3.1 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole, unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundations.

3.2 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a. IESNA LM-64, "Photometric Measurements of Parking Areas."
 - b. IESNA LM-72, "Directional Positioning of Photometric Data."

- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

SECTION 27130 – VOICE AND DATA COMMUNICATIONS CABLING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 RELATED WORK

- A. Section 26053 "Raceways and Boxes for Electrical Systems"
- B. Division 26 "Electrical"

1.2 SUMMARY

- A. This Section includes wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice and high-speed data transmission.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. IDC: Insulation displacement connector.
- C. LAN: Local area network.
- D. PVC: Polyvinyl chloride.
- E. STP: Shielded twisted pair.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data (if requested by Owner):
 - 1. Include data on features, ratings, and performance for each component specified.
- B. Shop Drawings (if requested by Owner):
 - 1. Include dimensioned plan and elevation views. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.
- C. Product Certificates (if requested by Owner):
 - 1. For each type of cable, connector, and terminal equipment, signed by product manufacturer.
- D. Manufacturer Seismic Qualification Certification (if requested by Owner): Submit certification that distribution racks and their components will withstand seismic forces defined in Division 26 Section "Seismic Controls for Electrical Work" when required by authority having jurisdiction. Include the following:
 - 1. Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. Indicate whether withstand certification is based on actual test of assembled components or on calculation:
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type, and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Operation and Maintenance Data: For voice and data communication cabling to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: As a minimum the installer must be certified by the termination manufacturer or by Building Industry Consulting Service International (BISCSI).
- B. Source Limitations: Obtain all products except twisted-pair and fiber cables through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute to other participants.
 - 3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.0 SYSTEM REQUIREMENTS

- A. General Requirements: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

2.1 MOUNTING ELEMENTS

- A. Cable Supports: Comply with Division 26 Section "Basic Electrical Materials and Methods."
- B. Raceways and Boxes: Comply with Division 26 Section "Raceways and Boxes."
- C. Backboards: 3/4-inch, interior-grade, fire-retardant-treated plywood.
- D. Distribution Racks: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

2.2 POS TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

- A. Cat5 Patch Cables - (8) Eight Conductors.
 - 1. (6-10 cables for printers, server, switch, router, thin clients). The number depends on the number of thin client terminals). One orange (Server DRAC to router), one Green (Server E net to router), One Yellow (Used by wiring tech DSL to router), two blue (Laser printers to Switch), One gray for each remote workstation plus one Gray for the DMARC extension to DSL Modem (used from the biscuit jack to the switch and DSL Modem, installed by the cable installer).
 - 2. Cable is run pin to pin
 - 3. Utilize 1" EMT conduit from main work station computer to DSL terminal.
 - 4. Utilize ½" minimum EMT conduit to each remote POS podium.
- B. Conductors: Solid copper.

- C. Jacks and Jack Assemblies for Cat 5 Cable: Modular, color-coded, RJ-11 receptacle units with integral IDC-type terminals. Use keyed jacks for data service.
- M. Data Outlets: Dual jack-connector assemblies mounted in single or multi-gang faceplate.
 - 1. Faceplate: High-impact plastic.
 - 2. Mounting: Flush, unless otherwise indicated.
 - 3. Legend: Factory labeled, "Voice" and "Data," by silk-screening or engraving.

2.3 IDENTIFICATION PRODUCTS

- A. Comply with Division 26 Section "Identification for Electrical Systems" and the following:
 - 1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

PART 3 - EXECUTION

3.0 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, cable supports, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 INSTALLATION

- A. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, and counters and except in accessible ceiling spaces where unenclosed wiring supports method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- B. Install cables using techniques, practices, and methods that are consistent with Category 5 rating of components and that ensure Category 5 performance of completed and linked signal paths, end to end.
- C. Install cables without damaging conductors, shield, or jacket.
- D. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- E. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
 - 1. Pull cables simultaneously if more than one is being installed in same raceway.
 - 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 - 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
- G. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- H. Wiring within Wiring Cabinets and Enclosures: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- I. Separation of Wires: Comply with TIA/EIA-569-A rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines, conduits, lighting fixtures, motors, transformers, and other electrical equipment.
- J. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
- K. Use splice and tap connectors compatible with media types.

3.2 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding."
- B. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- C. Bond shields and drain conductors to ground at only one point in each circuit.
- D. Signal Ground Terminal: Locate in each cabinet and enclosure; isolate from power system and equipment grounding.

3.3 INSTALLATION IN EQUIPMENT ROOMS

- A. Install plywood backboards on wall of equipment room(s).
- B. Mount patch panels, terminal strips, and other connecting hardware on backboards, unless otherwise indicated.
- C. Group connecting hardware for cables into separate logical fields.
- D. Use patch panels to terminate cables entering the space, unless otherwise indicated.

3.4 INSTALLATION STANDARDS

- A. Comply with requirements in TIA/EIA-568-A and TIA/EIA-569-A.

3.5 IDENTIFICATION

- A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems " and TIA/EIA-606.
- B. Data jack location: Label cables within outlet boxes.
- C. Distribution Cabinets, Racks, Enclosures and Frames: Label each unit and field within that unit.
- D. Within Connector Fields in Equipment Rooms: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- E. Cables, General: Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
- F. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
- G. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover.
- H. Use jacket color coding standard for cabling serving different functions such as voice, data, security, and video.

3.6 CLEANING

- A. On completion of system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

2. Copper Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bi-directional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-TSB67, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems." Link performance for UTP cables must meet minimum criteria of TIA/EIA-568-A.
 3. Fiber-Optic Cable Procedures: Perform each visual and mechanical inspection and electrical test, including optional procedures, stated in NETA ATS, Section 7.25. Certify compliance with test parameters and manufacturer's written recommendations. Test optical performance with optical power meter capable of generating light at all appropriate wavelengths.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

SECTION 31000 - EARTHWORK**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 RELATED WORK

- A. Section 31100 - Site Clearing
- B. Section 32930 - Landscaping
- C. Section 31231 – Rock Removal

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase course for concrete walks and pavements.
 - 5. Subbase and base course for asphalt paving.
 - 6. Subsurface drainage backfill for walls and trenches.
 - 7. Excavating and backfilling for utility trenches.
 - 8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 PRODUCTS

2.0 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 6 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter and possessing an Atterberg plasticity index between 4 and 15 percent, with a liquid limit of 35 percent or less.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.1 ACCESSORIES

- A. Warning Tape: Acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities.

PART 3 EXECUTION

3.0 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

3.1 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.2 GENERAL

- A. Perform earthwork in compliance with applicable codes and standards and governing authorities having jurisdiction.
- B. Soils, Testing, and Inspection Service. The General Contractor shall engage a Registered Soils Engineer for continuous inspections and quality control testing during all earthwork and dewatering operations. Refer to Geotechnical Report for additional information.
- C. Various utilities exist on this site. Known utilities are noted on the drawings. This Contractor shall contact local utility companies to verify the location of any underground utilities before earthwork is started. Protect all overhead and underground utilities on the site and along the rights-of-ways and neighboring facilities at all times.
- D. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation (work), consult Utility Company immediately for directions. Cooperate with Owner and Utility Companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Utility Company.
- E. Do not interrupt existing utilities serving the existing facility, except when permitted in writing and then only after acceptable temporary utility services have been provided.
- F. The General Contractor shall establish permanent benchmarks. The Earthwork Contractor shall maintain and protect these permanent benchmarks on the site for future construction on the site. Location of benchmarks shall be approved by the Owner's Representative. The Contractor shall provide base lines, levels, and grade stakes for work under this Section. Accuracy of such lines, levels, locations, benchmarks, and grades shall remain the General Contractor's responsibility.
- G. The Earthwork Contractor shall provide a system of drainage ditches, pumps, and lines or other approved methods to limit free water seepage into fill or compacted areas. It is important to note that soil materials on this site will be damaged by exposure to standing water. Therefore, all precautions must be taken to limit standing water and seepage during the construction period.
- H. Use only soil materials approved by the Owner's soils testing and inspection service in fill and cut areas. Unsatisfactory soil materials not approved for fill or compaction shall be removed from the site. Any unacceptable excavated material, trash, and debris shall be disposed of off the Owner's property in an approved manner.

3.3 DETAILED REQUIREMENTS

- A. Prior to start of any excavation, cut, and/or fill work, proof roll areas to receive fill to determine soft and/or unstable areas. Undercut, backfill, and compact such areas as directed by Owner's Representative and/or Soils Engineer.
- B. Compaction:
 - 1. Control soil compaction during construction. Provide minimum percentage of density specified for each area. Compact soil to not less than the following percentages of maximum dry density in accordance with ASTM D-698, "Standard Proctor Method for Compacting and Density of Soil."
 - a. Building area and slabs on grade: 100% of maximum dry density.
 - b. Paved road, dock areas, and parking areas: 100% of maximum dry density.
 - c. Lawn or unimproved areas: 90% of maximum dry density.
- C. Moisture Control:
 - 1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material to obtain proper moisture content to properly compact materials.
 - 2. Remove and replace, or scarify and air dry, soil materials that are too wet to obtain the degree of compaction required.
- D. Excavation, Earth Cut, and Fill Work:
 - 1. Excavated and cut material approved by the Owner's soil testing and inspection service as approved fill material shall be deposited, spread uniformly and compact to the proper density.
 - 2. Prior to start of excavation work, a sample of excavated material to be used for fill shall be submitted to the Soils Testing Engineer for approval.
 - 3. Offsite fill material shall be submitted to the Soils Engineer for approval. Place fill materials in layers not exceeding 12" in loose form prior to compaction.
 - 4. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density.
 - 5. Do not place fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 6. Earth cut and excavated material used for fill material shall be free from vegetable matter, rubbish, large rock, or other deleterious material not approved by the Soils Engineer. Any material to be used for fills shall first be approved by the Soils Engineer.
 - 7. Grade finished subgrade surfaces, free from irregular surface changes, to within plus or minus 0.1' subgrades required by the drawings. Subgrade Elevations:
 - a. Concrete paved areas: 12" below top of concrete paving.
 - b. Interior floor slabs: 12" below top of finished slabs.
 - c. Lawn areas: 6" below finish grade.
- E. Foundation Excavation:
 - 1. Foundation excavation consists of removal and disposal of material encountered when establishing required footing grade elevations.
 - 2. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Owner. Unauthorized excavation as well as remedial work directed by the Owner shall be at Contractor's expenses.
 - 3. Under footings or foundation bases, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to the Owner.
 - 4. Elsewhere backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Owner.
 - 5. Additional Excavation: When excavation has reached required subgrade elevations, notify Owner's Soils Engineer who will make an inspection of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the Owner's Soils Engineer. Removal of unsuitable material and its replacement as directed will be paid on the basis of unit price approved by the Owner's Project Engineer.
 - 6. Stability of Excavations: Slope side of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions

- or stability of material excavated. Provide materials that comply with local codes and authorities having jurisdiction.
7. Maintain sides and slopes of excavation in safe condition until completion of backfilling.
 8. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.
 9. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 10. Excavation for Structures. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 ft., and extending a sufficient distance from fittings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 11. In excavating for footings and foundations, take care not to disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive other work.
- F. Distribution of Topsoil:
1. Disc subgrade to a depth of 2" to 3", removing stones and clods over 2" in diameter prior to spreading topsoil.
 2. Topsoil, taken from on site stockpile, shall be distributed in minimum 6" layer over all areas disturbed by construction and/or noted on drawings to receive topsoil.
 3. Bring topsoil at least 1" above paved areas and final grade lines.
 4. Hand dress surface to a smooth, even grade, removing all stones and clods over 1" in diameter.
- Sod:
1. Contractor shall sod all existing areas damaged by construction and all areas where topsoil has been distributed. Sod, and fertilizer, shall be approved by the owner's Representative.
 2. Sod type: as specified on drawings or recommended from local extension service. A Tall Turf-Type fescue should be used in most lawn applications unless otherwise specified. Sod mix should be 80% to 100% germination.
 3. Fertilizer: Commercial 10-10-10, distributed 20 lbs. per 1,000 sq. ft.

SECTION 31100 - SITE CLEARING**PART 1 - GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees to remain.
 - 2. Removal of designated trees and other vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, and removing site utilities.
 - 7. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
 - 1. Section 02060 "Demolition" for demolition of buildings, structures, and site improvements.
 - 2. Section 31000 "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.2 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.3 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Owner's Representative.
- C. Utility Locator Service: Notify utility locator service for location of utilities before site clearing.

- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.0 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Section 31000 "Earthwork."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.0 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to a sediment and erosion control plan, specific to the site, complying with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within fenced area.
 - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
 - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
 - 1. Cover exposed roots with burlap and water regularly.
 - 2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 - 4. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.
 - 1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.

2. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.

3.3 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving adjacent facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner approval.
- C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 4. Use only hand methods for grubbing within tree protection zone.
 5. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground or specified compaction requirements if in build zone.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Limit height of topsoil stockpiles to 72 inches.
 2. Do not stockpile topsoil within tree protection zones.
 3. Dispose of excess topsoil as specified for waste material disposal.
 4. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.6 SITE IMPROVEMENTS

- A. Remove existing above and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 1. Unless existing, full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
 - 1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

SECTION 31231 – ROCK REMOVAL**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 RELATED WORK

Earthwork: Section 31000

1.2 UNIT PRICES FOR ADDED OR DEDUCTED WORK

- A. Do not exceed the quantities of rock removal indicated by numeric units on the Drawings, except by Order on Contract. In order to avoid delay, notify the Owner's Representative when the amount of completed Work approaches the quantity indicated.
- B. If the removed quantity of rock is greater than the numeric units of Work indicated on the Drawings, the contract sum will be adjusted by an Order on Contract. If the removed quantity of rock is less than the numeric units of Work indicated on the Drawings, the contract sum will be adjusted via a Supplemental Agreement (BDC 134) at time of final payment at the following unit prices:
1. Added General Rock Removal @ \$ _____ per cu yd.
 2. Deducted General Rock Removal @ \$ _____ per cu yd.
 3. Added Trench and Pier Rock Removal @ \$ _____ per cu yd.
 4. Deducted Trench and Pier Rock Removal @ \$ _____ per cu yd.
- D. The foregoing unit prices include test pits, overhead, profit, and all other expenses incidental to the Work. Include in the bid sum all additional costs in connection with quantity changes that are not compensated for at the given unit prices.
- E. The unit price for additional rock removal is over and above the cost of earth excavation. No deduction from the bid sum will be taken for reduced quantities of earth excavation resulting from additional rock removal.
- F. The unit price for deducted rock removal takes into account and is deemed to compensate for the cost (including overhead, profit and all other expense items) of earth excavation in lieu of rock removal. No additional payment will be made for such additional earth excavation.
- G. If the total amount of a change exceeds 20 percent of the aforementioned quantity indicated on the Drawings, the adjustment of the contract sum for the quantity in excess of 20 percent will be made in accordance with the General Conditions.
- H. Measurement: Rock quantities will be determined by measuring rock in place prior to removal. Measurements shall be taken of the actual rock cut, as required for the Work, or to the specified measurement limits, whichever is smaller. Unless otherwise directed in writing, measurement limits shall be as follows:
1. Cast-In-Place Concrete:
 - a. Vertical Limit: Bottom of rock cut for cast-in-place concrete bearing on rock shall be the bottom of concrete elevation indicated on the Drawings.
 - b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth of Rock Cut	Distance Beyond Edge of Concrete in Each Direction
Under 3 Feet	18 Inches
3 to 15 Feet	24 Inches
Over 15 Feet	30 Inches

2. Precast Concrete Structures: Measurement will be based on the size of the precast concrete structure specified or indicated on the Drawings.
 - a. Vertical Limit: Bottom of rock cut for precast concrete structure shall be 12 inches below the required bottom of structure elevation.
 - b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth of Rock Cut	Distance Beyond Edge of Concrete in Each Direction
Under 5 Feet	12 Inches
5 to 15 Feet	18 Inches
Over 15 Feet	24 Inches

3. Pipe:
 - a. Vertical Limit: Bottom of rock cut for pipe in trench shall be 6 inches below the required pipe invert elevation, with depth measured from the mean surface of the rock.
 - b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth of Rock Cut	Trench Width
Under 10 Feet	24 Inches plus Pipe OD
10 to 15 Feet	36 Inches plus Pipe OD
Over 15 Feet	48 Inches plus Pipe OD

4. Conduit:
 - a. Vertical Limit: Bottom of rock cut for conduit in trench shall be as required for the indicated depth of the conduit.
 - b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth of Rock Cut	Trench Width
Under 3 Feet	24 Inches, except where wider width is required by the multiple horizontal conduits.
3 to 10 Feet	36 Inches, except where wider width is required by the Drawings or directed for multiple horizontal conduits.

5. Foundation Drains: Where drains and foundation share the same rock cut, the horizontal measurement limit, on the drain side of the footing, shall be 30 inches from edge of concrete to vertical side surface of rock at bottom of cut unless otherwise shown on the Drawings.

1.3 REFERENCES

- A. Comply with the applicable requirements of the Code of Federal Regulations Title 29 - Labor, Part 1926 Safety and Health Regulations for Construction (OSHA).

1.4 DEFINITIONS

- A. Rock: Limestone, sandstone, shale, granite, and similar material in solid beds or masses in its original or stratified position which can be removed only by ripping, drilling, wedging, or use of pneumatic tools, and boulders with a volume greater than 1.0 cu yd. Concrete building foundations and concrete slabs, not indicated, with a volume greater than 1.0 cu yd shall be classified as rock.
 1. Materials which can be loosened with a pick or backhoe, frozen materials, soft laminated shale or hardpan, pavements, curbs, and similar materials shall be classified as earth excavation. Concrete building foundations and concrete slabs,

- where indicated, shall be classified as earth excavation. Masonry building foundations, whether indicated or not, shall be classified as earth excavation.
- B. Unauthorized Rock Removal: The removal of material below required elevation indicated on the Drawings or beyond lateral dimensions indicated or specified without specific written direction by the Owner's Representative.
 - C. General Rock Removal: Quantities of rock removal will be paid for as General Rock Removal when:
 - 1. The width of rock removed, as per measurement limits, is greater than or equal to the total excavation depth required.
 - 2. Boulders removed have a volume greater than 1.0 cu yd.
 - D. Trench and Pier Rock Removal: Quantities of rock removal will be paid for as Trench and Pier Rock Removal when the width of rock removed, as per measurement limits, is less than the total excavation depth required.

1.5 SUBMITTALS

- A. Rock Removal Procedure (if requested by Owner): Submit a detailed outline of intended rock removal procedure. This submittal will not relieve the Contractor of responsibility for the successful performance of method used.
- B. Quality Control Submittals (if requested by Owner):
 - 1. Certificates: Competency affidavit required under
 - a. Name, and employer's name, business address and telephone number.
 - b. Names and addresses of the required number of similar projects which meet the experience criteria.
- C. Measurement data for quantities of rock removal.

1.6 QUALITY ASSURANCE

- A. Pre-Rock Removal Conference: Before the rock removal work is scheduled to commence, a conference will be called by the Owner's Representative at the site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by the Contractor's Representative and the person supervising the rock removal operations.

1.07 PROJECT CONDITIONS

- A. Blasting and the use of explosive materials will not be permitted. Keep proper daily records, including drilling logs, disposal manifests, etc.
- C. Obtain photos, and other related structural data of nearby structures to record and measure impact of removal operations.

PART 2 PRODUCTS

2.0 MATERIALS

- A. Backfill Materials and Other Related Earthwork: As specified in Section 31000.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examination of Existing Property and Construction: Prior to starting rock removal Work, thoroughly examine the existing property and construction at the site and record, with notes and drawings or other documentation, existing defects and deterioration. Make this information available to the Director's Representative upon request.

- B. Measure and record condition of existing foundation walls, building interior walls and ceiling, exterior masonry, glass, etc. prior to excavation procedures.

3.1 ROCK REMOVAL

- A. Remove rock as required by the Drawings and as necessary for the installation of the Work. Make sufficient clearance, within the limits specified, for the proper execution of the Work.

3.2 FIELD QUALITY CONTROL

- A. Notify the Owner's Representative at least 3 work days in advance of all phases of rock removal.
- B. Allow time for visual inspection of bottom of rock cut required for the Work.

3.4 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS.

- A. Remove and dispose of excess and unsuitable rock materials.

3.6 CLEANING

- A. Where footings and walls will rest entirely on rock, clean rock surfaces free of soil and loose rock.
- B. Clean neighboring properties affected by excavation and removal procedures.

SECTION 31330 – GEOTEXTILES / GEOMATRIXES**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 SECTION INCLUDES

- A. Geogrid installation
- B. Soil/granular fill placement over geogrid

1.2 RELATED WORK

- A. Section 31000 – Earthwork
- B. Geotechnical Evaluation – if available

1.3 SUBMITTALS

- A. Product Data (if requested by Owner):
 - 1. Samples of specified product.
- 2. Test certificates verifying the following:
 - a. Tensile Test
 - 1) Uniaxial (if applicable)
 - 2) Biaxial (if applicable)
 - b. Creep Test

1.4 DELIVERY, STORAGE, AND HANDLING

- A. The contractor shall check the geogrid, upon delivery, to assure the proper material has been received.
- B. Special care shall be taken in the handling of geogrids manufactured from polypropylene at temperatures at or below 0 degrees F.

PART 2 PRODUCTS**2.0 DEFINITIONS**

- A. Geogrid: a polymer grid structure is manufactured from a punched polypropylene sheet, oriented in multiple, equilateral directions to form a triangular aperture, delivering high radial stiffness throughout the full 360 degrees specifically fabricated for use as a soil reinforcement.
- B. Biaxial grid: a geogrid which has been manufactured using select grades of polypropylene or copolymers that resist high, short-term dynamic loads or moderate loads over longer time periods. These products carry loads applied in any direction in the plane of the geogrid.

2.1 ACCEPTABLE MANUFACTURERS

- A. The geogrid shall be Tensar Triax Geogrid as shown on engineering plans and as manufactured by the Tensar Corporation, Morrow, Georgia.
- B. Biaxial grid shall be Tensar Biaxial bx Geogrid as shown on engineering plans and as manufactured by the Tensar Corporation, Morrow, Georgia.

PART 3 EXECUTION**3.0 SUBGRADE SOIL PREPARATION**

- A. Subgrade soil shall be prepared as indicated on the construction drawings and as directed by the Owner's Representative.
- B. All sharp objects and any boulders shall be removed from the subgrade surface prior to placement of the geogrid.

3.1 GEOGRID INSTALLATION

- A. Geogrid shall be laid at the proper elevation and alignment as shown on the construction drawings.
- B. Geogrid shall be oriented such that the roll length runs parallel to the road direction.
- C. Overlaps:
 - 1. Geogrid sections shall be overlapped as indicated on the construction drawing or as recommended by manufacturer.
 - 2. Minimum overlap is 1 foot.
- D. Geogrid sections shall be joined along overlaps at intervals of 10 feet with wire or plastic ties wrapped around a web from each roll.
- E. Geogrid material shall be tensioned by hand and secured to the ground surface by:
 - 1. Staking at 10 foot intervals by use of 6" soil pins; or
 - 2. Placement of loose fill at the corners and edges; or
 - 3. Per manufacturer's recommendations.
- F. Care shall be taken to ensure that geogrid sections do not separate at overlaps during construction.
- G. Placement of geogrid around corners will require cutting of geogrid product and diagonal overlapping of same to ensure that excessive bulking of grid material does not occur.

3.2 SOIL GRANULAR FILL PLACEMENT OVER GEOGRID

- A. Soil granular fill material shall be placed in lift thicknesses and compacted as directed under Section 31000.
- B. Granular fill material shall be back dumped from trucks riding on top of the reinforced fill and bladed onto geogrid in such a manner that the fill rolls onto the grid ahead (e.g. by gradually raising dozer blade while moving forward).
- C. Tracked construction equipment shall not operate directly upon the geogrid. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid.

SECTION 32120 – ASPHALT PAVING**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 RELATED WORK

- A. Geotechnical Soils Report (if applicable)
- B. Division 31 - Earthwork
- C. Section 09910 - Painting: For pavement marking materials

1.2 SECTION INCLUDES

- A. Base course.
- B. Hot-mixed asphaltic concrete.
- C. Coal-Tar Sealer
- D. Pavement marking.

1.3 SYSTEM DESCRIPTION

- A. Aggregate base design:
 - 1. Provide paving design per specified materials in the following thicknesses:
 - a. Base Course: 8" crushed stone.
 - b. Binder Course: 1 1/2" of asphaltic concrete.
 - c. Surface Course: 1" of asphaltic concrete.
- B. Full depth asphalt design (Contractor shall submit an alternate bid stating the amount to be added to or deducted from his bid for substitution of full-depth asphalt in lieu of aggregate base design.):
 - 1. Provide paving design per specified materials in the following thicknesses:
 - a. Base Course: 4 1/2" of asphaltic concrete.
 - b. Surface Course: 2" of asphaltic concrete.

1.4 PROJECT CONDITIONS

- A. Application Requirements:
 - 1. Apply tack coats only when ambient temperature is above 50 degrees F., and when temperature has not been below 35 degrees F., for 12 hours immediately prior to application. Do not apply when base is wet.
 - 2. Construct asphalt surface course only when atmospheric temperature is above 40 degrees F., and when asphalt base is dry and clean. Asphalt base course may be placed when air temperature is above 30 degrees F., and rising and when aggregate base is dry.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. General: Use locally available materials and gradations which exhibit a satisfactory record of previous installations.

- B. Base Course: 100 percent crushed stone, gradation for dense-graded aggregate as required by applicable the State Highway Department.
- C. Asphalt Materials: Materials and application shall conform to the Department of Transportation specifications of the State in which the work is done, for Class I Type B Hot-Mix asphaltic concrete. Hot-Mix materials shall develop a minimum of 750 pounds stability, and a flow value between 8 and 16.
- D. Tack Coat: Cutback asphalt, RC-250.
- E. Coal-Tar Sealer: Material must be fuel resistant in field use conforming to ASTM-D490, Grade 12; ASTM D20 (% by weight to 300, Max. 60); ASTM-D36 (65 Max.)

PART 3 EXECUTION

3.0 PREPARATION

- A. Verify elevations of rough grade work. Remove, reshape, or provide sufficient material where necessary to provide required thickness of base and bituminous areas. Remove rutted areas or windrowing resulting from truck traffic.
- B. Subgrade preparation under the aggregate base shall conform to the Department of Transportation Specifications. This work shall be done after unstable sections of the subgrade have been repaired and after existing base and surface courses required to be removed have been removed.
- C. The required density of the subgrade shall be 95% of the maximum standard Proctor density in the upper 36" below the paving.

3.1 PROTECTION

- A. Protect concrete flatwork, curbs landscaping, building walls, etc. from spatters, wheel and track marking, rollers, and any other damages that could occur from this work.
 - 1. Apply a layer of sand on flat concrete surfaces to protect from tack smears and tire and track marks.
- B. Keep hot asphalt in transport trucks covered with tarps from plant to site.

3.2 PLACING AGGREGATE BASE COURSE

- A. Apply over the compacted subgrade, the aggregate base of the thickness and material specified in two equal lifts.
 - 1. Stone used during construction as a temporary base shall not be included in the thickness required for base.
 - 2. The aggregate base shall be compacted to minimum 95% of the modified Proctor density.
 - 3. The finished surface of the aggregate base course shall not vary more than 0.05 feet from the elevations, grades and cross-sections shown on the Drawings.
 - 4. After base is completed, it shall be proof-rolled and checked by Owner's Representative before placement of Bituminous paving.

3.3 PLACING ASPHALT BINDER AND SURFACE COURSES

- A. General:
 - 1. Place bituminous mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 degrees F. Place inaccessible and small areas by hand. Place each course to required grade, cross section, and compacted thickness. The mix shall be placed and rolled in accordance with state specifications and as specified herein.
 - 2. Placing: Place in strips not less than 10 feet wide, unless area configuration does not allow. After first strip has been placed and rolled, place succeeding strips and

- extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- a. Joints: Make joints between old and new pavements, and between successive day's work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.
 - b. Tack Coat: Apply to contact surfaces of previously constructed asphalt binder course and joints. Place at a consistency of approximately 0.05 gal./sq. yd. Allow to dry until at proper condition to receive paving.
3. Rolling: Begin rolling when mixture will bear roller weight without excessive displacement.
- a. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
 - b. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
 - c. Second Rolling: Follow breakdown rolling with second rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
 - d. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and the course has attained recommended maximum density.
 - e. After finish rolling, erect barricades to protect paving from traffic until mixture has cooled and attained its maximum degree of hardness.
 - f. Compact surface course to 95% of the maximum Marshall dry density.

3.4 COAL-TAR SEALER APPLICATION

- A. The coal-tar sealer shall be applied only when the existing surface is dry and the pavement surface temperature is above 50 degrees F and rising, but below 90°F for application. Do not over apply, which will result in tracking. Do not apply if rain or cold temperatures are expected within 36 hours.
- B. The Contractor shall furnish all equipment, tools, and machines necessary for the performance of the work.
 1. Pressure Distributor: The distributor shall be designed, equipped, maintained, and operated so that coal-tar sealer at even heat may be applied uniformly on variable widths of pavement at the specified rate.
 2. Power Broom: A power broom and/or blower shall be provided for removing loose material from the pavement surface.
- C. Prior to placing the sealer, the surface of the pavement shall be clean and free from dust, dirt, or other loose foreign matter with a power broom. Properly treat oil spots with Petro Seal spot cleaner.
- D. Fill structural cracks with a hot pour crack sealant or flexible cold applied sealant such as FlexMaster and follow manufacturer's recommendations.
- E. Mix well. Equipment shall have continuous agitation or mixing capabilities to maintain homogeneous consistency of pavement sealer mixture throughout the application process.
- F. An early cure additive may be necessary to meet curing requirements for opening of facility for business. Consult Owner
- G. Complete the entire driveway in one continuous application to prevent "color shading".
- H. Apply Sealmaster Coal Tar Emulsion Sealant exceeding Federal Specs RP-355E regulations at the rate of .20 gallons per square yard. Sealer contains 1% rubberized latex additive and fractured silica sand at the rate of 2 pounds per gallon."

- I. Sealer should be applied by either pressurized spray application equipment or self-propelled squeegee equipment. Pressurized spray equipment should be capable of spraying pavement
- I. Following the application, the surface shall be allowed to cure without being disturbed until the sealer has dried out. Suitable precautions shall be taken by the Contractor during this period, including the application of any sand necessary to blot up excess material.
- J. Check with Owner if a two-coat application is required.

3.5 PAVEMENT MARKING

- A. Layout parking spaces and traffic lines as shown and provide such incidental pavement marking as directed. Perform marking after surface course has been completed and before traffic is allowed on the pavement insofar as practicable.
 - 1. New pavement surfaces shall be allowed to cure for a period of not less than 20 days before application of marking materials, unless otherwise approved by the Owner's Representative.
- B. Surfaces to be marked shall be thoroughly cleaned before application of the paint.
 - 1. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required.
- C. Paint Application: The equipment for applying paint to pavements shall be a pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results.
 - 1. Rate of Application: Paint shall be applied evenly to the pavements surface to be coated at a rate of 400 s.f. per gallon. Striping shall be 4" in width.
 - 2. Paint shall be applied in 1 (one) coat.
 - 3. Markings shall be white, except blue in handicap stalls and yellow in service road. Refer to Division 9 Exterior Paint for product information.
 - 4. Paint shall be applied only when the air and pavement temperatures are above 40 degrees F. and less than 95 degrees F. Edges of markings shall be sharply outlined.
 - 5. Furnish temporary barriers until pavement markings have dried.

3.6 FIELD QUALITY CONTROL

- A. Compaction of paving subgrade and aggregate base shall be under the supervision of the testing laboratory.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
 - 1. Aggregate Base Course: 1/2", plus or minus.
 - 2. Asphaltic Concrete Binder and Surface Courses: 1/4", plus or minus.
- C. Surface Smoothness: Test finished surface of surface course for smoothness using a 10 foot straightedge applied parallel with and at right angles to centerline of paved area. Surface will not be acceptable if it exceeds a 3/16" tolerance for smoothness.
- D. If the above test indicate that Specifications have not been met, the Contractor shall pay for such additional tests as may be required to assure that compliance has been attained.
- E. If Owner elects, specimens shall be removed at locations designated by the Owner's Representative, and care shall be exercised to avoid damage to the specimens. The holes caused by the removal of the specimens shall be refilled by the Contractor immediately with an asphaltic material meeting these Specifications, compacted and finished to the satisfaction of the Owner, without additional cost to the Owner.

3.7 CLEAN-UP

- A. Remove all spatters, loose granuals, excess asphalt etc., from facility.
- B. Thoroughly remove dirt and contaminants resulting from application of driveway or from other trades.

SECTION 32130 - PORTLAND CEMENT CONCRETE PAVING**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

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

1.1 SUMMARY

- A. This Section specifies concrete paving, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
- B. Related Sections include the following:
 - 1. Geotechnical Report if applicable
 - 2. Division Section 03100 Concrete Formwork
 - 3. Division Section 03200 Concrete Reinforcing
 - 4. Division Section 03300 Cast-in-Place Concrete
 - 2. Division Section 31200 "Earth Moving" for drainage fill under slabs-on-grade.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- A. Product Data (if requested by Owner): For each type of product indicated.
- B. Design Mixtures (if requested by Owner): For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Welding certificates (if requested by Owner).
- D. Qualification Data (if requested by Owner): For Installer and testing agency.
- E. Material Test Reports (if requested by Owner): For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- F. Material Certificates (if requested by Owner): For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.

- 13. Repair materials.
- G. Field quality-control test and inspection reports (if requested by Owner).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 2. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 3. ACI 318, "Building Code Requirements for Structural Concrete."
- F. Concrete: Comply with Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
 - 1. Materials and mixes to perform quality control testing where required by Project Manager in accordance with General Conditions.
 - 2. Provide the services of a testing laboratory to design concrete mixes.
 - 3. Testing agency shall meet the requirements of ASTM E329.
 - 4. Selection of a testing laboratory is subject to the Project Manager's acceptance.
 - 5. Submit a written description of the proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities and equipment, and other information as may be requested by the Project Manager.
- H. Tests for Concrete Materials:
 - 1. For normal weight concrete, test aggregates by the methods of sampling and testing of ASTM C33.
 - 2. For Portland Cement, sample the cement and determine the properties by the methods of test of ASTM C150.
 - 3. Submit written reports for each material sampled and tested, prior to the start of Work. Provide the Project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not materials are acceptable for intended use.
- J. Certificates of material properties and compliances with specified requirements may be submitted in lieu of testing, when acceptable to the project Manager. Certificates of Compliance must be signed by the materials producer and the Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS**2.0 MANUFACTURERS**

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

2.1 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C 330, 1/2-inch nominal maximum aggregate size.
- E. Water: ASTM C 94 and potable.

2.2 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.
 - 1. Products:
 - a. Euclid Chemical Company; Eucon CIA.
 - b. Grace Construction Products, W. R. Grace & Co.; DCI.
 - c. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 - 1. Products:
 - a. Cortec Corporation; MCI 2005NS.
 - b. Grace Construction Products, W. R. Grace & Co.; DCI-S.
 - c. Sika Corporation; FerroGard-901.

2.3 FIBER REINFORCEMENT

- A. Carbon-Steel Fiber: ASTM A 820, deformed, minimum of 1.5 inches long, and aspect ratio of 45 to 50.
 - 1. Products:
 - a. Bekaert Corporation; Dramix.
 - b. Fibercon International, Inc.; Fibercon.
 - c. SI Concrete Systems; Zorex.
 - 2. Fiber: Type 2, cut sheet.
- B. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 3/4 inches long.
 - 1. Products:
 - a. Fibrillated Fibers:
 - 1) Euclid Chemical Company; Fiberstrand F.
 - 2) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
 - 3) SI Concrete Systems; Fibermesh.

2.4 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
 - 1. Products:
 - a. Fortifiber Corporation; Moistop Plus.
 - b. Raven Industries Inc.; Dura Skrim 8.
 - c. Reef Industries, Inc.; Griffolyn Type 85.
 - d. Stego Industries, LLC; Stego Wrap, 10 mils.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products:
 - a. ChemMasters; Spray-Film.
 - b. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - c. Dayton Superior Corporation; Sure Film.
 - d. Euclid Chemical Company; Eucobar.
 - e. L&M Construction Chemicals, Inc.; E-Con.
 - f. Meadows, W. R., Inc.; Sealtight Evapre.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Products:
 - a. ChemMasters; Safe-Cure Clear.
 - b. Conspec Marketing & Manufacturing Co., a Dayton Superior Company; W.B. Resin Cure.
 - c. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - d. Euclid Chemical Company; Kurez DR VOX.
 - e. L&M Construction Chemicals, Inc.; L&M Cure R.
 - f. Meadows, W. R., Inc.; 1100 Clear.
 - g. Tamms Industries, Inc.; Horncure WB 30.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336-inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- F. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.8 STEEL REINFORCEMENT

- A. Welded Wire Mesh. 6 x 6 x 2/2 @ .78/sf welded wire mesh, flat sheets. Install in all pavement area concrete. Install in center of slab. Secure reinforcing mesh in position using standard metal supports, spacers, and ties. Mesh to be ASTM A-185.
- B. Reinforcing Bars. Deformed steel bars, ASTM A 615, Grade 40.
- C. Joist Dowel Bars. Plain steel bars, ASTM A 615, Grade 40. Cut bars true to length with ends square and free of burrs.
- D. Metal Expansion Caps. Furnish for one end of each dowel bar in expansion joints. Design caps with one end closed and a minimum length of 3" to allow bars movement of not less than 1", unless otherwise indicated.
- E. Dowel Baskets. Equal to metal dowel baskets as manufactured by the Dayton Sure Grip and Shores Company.

PART 3 EXECUTION

3.0 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.1 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 1. Lap joints 12 inches and seal with manufacturer's recommended tape.

3.2 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete

develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.3 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Comply with ACI304, "Guide For Measuring, Mixing, Transporting and Placing Concrete," and as specified.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Owner's Representative.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed-water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 301 and as follows:
 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.4 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.5 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings
- C. Trowel Finish: Interior slabs only. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed. While concrete is still plastic, slightly scarify surface with a fine broom.
 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner's Representative before application.

3.6 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.7 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.9 CONCRETE SURFACE REPAIRS

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

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalling, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Owner's representative.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contrator will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
 - 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 7. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of three standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of three standard cylinder specimens for each composite sample.
 - 8. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

- a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Owner's representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's representative but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner's representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Owner's representative
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate that they do not comply with the Contract Documents. The corrections and any other work affected by or resulting from corrections to the concrete work shall be at the Contractor's expense.

SECTION 32160 – CONCRETE CURBS AND GUTTERS**PART 1 GENERAL****1.0 SECTION INCLUDES**

- A. Machine-placed concrete curbs and integral gutters.
- B. Cast in place concrete curbs

1.1 RELATED SECTIONS

- A. Division 31 - Earthwork
- B. Section 03300 - Cast in Place Concrete

1.2 REFERENCES

- A. Comply with the provisions of local requirements, specifications, and minimum standards.

1.3 SUBMITTALS

- A. Submit the following if requested by Owner in accordance with General Requirements:
 - 1. Mix Design: Concrete mix design, including report on design strength test.
 - 2. Test reports on placed concrete:
 - a. Tests of materials, or review of test reports available from suppliers.
 - b. Field tests as specified herein.

1.4 QUALITY ASSURANCE

- A. Curbs on public property shall comply with all laws, rules and regulations of governmental authorities having jurisdiction over such work.

PART 2 PRODUCTS**2.0 MATERIALS**

- A. Portland Cement: ASTM C150, Type I, normal Portland cement; uniform gray color, from a single source.
- B. Aggregates: All fine and coarse aggregate shall conform to ASTM C33.
 - 1. Fine Aggregates: Natural or artificial, hard clean sand.
 - 2. Coarse Aggregates: Crushed stone, size 57.
- C. Water: Potable.
- D. Air Entraining Admixture: ASTM C260, "Air Mix" (The Euclid Chemical Co.); "Darex" (W.R. Grace & Co.); "Sika AER" (Sika Chemical Corp.); add only to normal portland cement concrete to meet requirements specified for air content.
- E. Liquid Membrane Curing and Sealing Compound: ASTM C309, Type 1, acrylic based, 18 percent minimum solids for use on vertical and horizontal surfaces, guaranteed not to affect bond on applied finishes, "Clear Bond" (Guardian Chemical Co., 708 Jefferson St., Atlanta, GA); Master Builder "Kore N Seal 800", "MB-429".
- F. Preformed Asphaltic Fiber Joint Filler: ASTM D1751, "Fiber Expansion Joint Filler, Code 1390" (W.R. Grace & Co.), non-extruding, for expansion joints which are to be sealed.
- G. Joint Sealer: Hot poured rubber asphalt type, "Papa-Plastic" (W.R. Grace & Co.); "HiSpec" (W. R. Meadows, Inc.); or approved substitution.

2.1 PROPORTIONING AND MIXING

- A. The testing laboratory shall design the mix for the concrete to obtain a strength, as determined by test cylinders, at least 15% higher than specified.
- C. The testing laboratory shall submit the copies of the mix design and the test results to the Owner.
- D. Cement content shall meet the design strength of 4,000 psi.
- E. Ready-Mixed Concrete shall conform with ASTM C94.
- F. The mixture shall contain no more water than is necessary to produce concrete which is workable and plastic within the limits specified herein for slump. The amount of water and proportion of mortar to coarse aggregate shall be the least which will produce uniformly dense concrete, free from aggregate pockets or honeycomb. Corrections shall be made for the amount of moisture contained in the aggregates and allowances shall be made for absorption of moisture by the aggregates during the period of mixing and handling. A uniform consistency shall be maintained continuously. Mixture shall contain 5-7% air entrainment. NO CALCIUM CHLORIDE shall be used. No water is to be added to the mix at the job site without approval from Owner's Representative.
- G. The consistency shall be determined by the method specified in ASTM C143.
- H. In general the slump shall be not less than 3" nor more than 5" for concrete which is not compacted by vibration; and not less than 2" or more than 4" for concrete which is compacted by vibration. In each of the above cases, slumps outside of the limits named may be used when satisfactory workability cannot be obtained within such limits and the slump is approved by the Owner's Representative.

PART 3 EXECUTION

3.0 PREPARING SUBGRADE

- A. Prior to fine grading, the rough grade shall be tamped or rolled until thoroughly compacted and shall be constructed true to grade and cross section.
- B. Fine grading and filling shall be performed using sand, or other granular subbase, uniformly graded. Subgrade shall be tested with an approved template. High spots shall be lowered and low spots raised. Subbase shall be compacted and leveled to grade.
- C. Wet the prepared subgrade to ensure a moist condition when concrete is placed.

3.1 MACHINE PLACED AND NON-REINFORCED CONCRETE CURBS

- A. Place and form concrete to the required shape with an approved type of extrusion machine. The face of the finished curb shall be true and straight, and the top surface of curbs shall be of uniform width, free from humps, sags, or other irregularities. When a straightedge 10 feet long is laid on the top or face of the curb, the surface shall not vary more than 1/4" from the edge of the straightedge, except at grade changes or curves. All visible surfaces and edges of the finished curb shall be free of all blemishes and tool marks and shall be uniform in color, shape and appearance.
- B. Expansion joints and contraction joints shall be provided in all curbs, and shall be constructed at right angles to the line of curb, as specified herein and as shown.
 - 1. Contraction joints shall be formed in the wet concrete by cutting a groove 2" in depth in all exposed surfaces using an approved cutting tool have a blade 1/8" wide. Provide contraction joints every 10 feet.
 - 2. Expansion joints shall be formed by means of the specified type performed filler material 1/2" thick, cut and shaped to the cross-section of the curb. Expansion joints shall be provided in curbs at the ends of all returns, changes in directions and directly opposite the expansion joints of abutting concrete pavement, and unless otherwise shown shall be of the same thickness as the joints in the pavement. Provide expansion joints not to exceed 50 feet o.c.

3.2 CAST-IN-PLACE REINFORCED CONCRETE CURBS

- A. Provide control joints at 25 feet and expansion joints at 75 feet.

3.3 PLACING CONCRETE DURING HOT AND COLD WEATHER

- A. During cold weather, equipment and materials shall be provided to maintain a temperature of at least 50 degrees F. in the freshly placed concrete during the curing period. No frozen materials or materials containing snow or ice shall be used in the mix. No dependence shall be placed on salt or other chemicals for the prevention of freezing. No concrete shall be placed on frozen subgrade.
- B. During hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing. Windbreaks, sunshades, covering, fog sprays, etc. shall be used as required, or directed by the Owner. Concrete deposited in hot weather shall have a placing temperature not greater than 80 degrees F., and shall be maintained at a temperature not greater than 90 degrees F during the curing period.

SECTION 32165 – SEGMENTAL CONCRETE RETAINING WALL**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

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

1.1 SECTION INCLUDES

- A. Segmental concrete retaining wall.
- B. Related materials required for construction of wall.

1.2 RELATED SECTIONS

- A. Division 31 - Earthwork

1.3 SUBMITTALS

- A. Submit the following if requested by Owner:
 - 1. Manufacturer's information of specified product.
 - 2. Test certificates verifying the following:
 - a. Load Bearing (ASTM - C90)
 - b. Testing of concrete masonry (ASTM - C140)

1.4 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall check the materials, upon delivery, to assure the proper material has been received.
- B. Special care shall be taken in the handling of units from coming in contact with mud, cement, etc.

PART 2 PRODUCTS**2.0 SEGMENTAL CONCRETE RETAINING WALL UNITS**

- A. Segmental concrete units shall conform to the following requirements:
 - 1. Face finish - sculptured rockface, striated, or as specified by the owner.
 - 2. Compressive strength at least 3000 psi.
 - 3. Adsorption not to exceed 6%.
 - 4. Shear strength between vertically adjacent units at least 1,500 plf minimum at normal pressure of 2 psi and greater.
 - 5. Exterior dimensions may vary in accordance with ASTM C90-85. Standard units shall have a minimum of 1 square foot area each.
 - 6. Units shall be interlocked and provide a built-in setback of 1:8.

2.1 SHEAR CONNECTORS

- A. Strength of shear connectors between vertical adjacent units shall be applicable over a design temperature of -10 degrees Fahrenheit to +100 degrees Fahrenheit.

2.2 BASE LEVELING PAD MATERIAL

- A. Material shall consist of compacted angular sand, gravel, crushed rock or leveling concrete (non-reinforced).

2.3 UNIT FILL

- A. Fill for units shall be free draining crushed stone or coarse gravel, 3/8-inch to 3/4-inch, with no more than 5 percent passing the No. 200 sieve.
- B. Place recommended fill behind the retaining wall units a minimum of six inches.

2.4 BACKFILL

- A. Material shall be site excavated soils or as per project drawings. Unsuitable soils for backfill (heavy clays or organic soils) shall not be used in the backfill.

PART 3 EXECUTION**3.0 EXCAVATION**

- A. Contractor shall excavate to the lines and grades shown on the drawings. Contractor shall be careful not to disturb embankment materials beyond lines shown.

3.1 BASE LEVELING PAD

- A. Leveling pad materials shall be placed as shown on the drawings, upon approved foundation, to a minimum thickness of 6 inches.
- B. Material shall be compacted so as to provide a level surface on which to place the first course of units. Compaction shall be to 95 percent of Standard Proctor for sand or gravel type materials. For crushed rock material shall be densely compacted.
- C. Leveling pad may be eliminated for walls less than 3 feet in height if existing site soils are inorganic, well draining, and naturally compacted.
- D. Contractor may opt for using reduced depth of sands, gravel or crushed rock using a concrete topping. Concrete shall be unreinforced and a maximum of 3 inches thick.

3.2 GEOGRID INSTALLATION

- A. When shown on the drawings or when the wall is of specific height whereby the unit manufacturer requires geogrid for tie-back support, geogrid shall be installed as per manufacturer's specifications.
- B. Geotextiles are recommended over cohesive soils, i.e. clays or silts. They are also a good choice over soils saturated for a large portion of the year.
- C. Utilize woven geotextile material.
- D. Overlap and cover the sides of the excavation. Create an overlap in the direction of the grade, much like shingles on a house. Begin by placing the fabric at the lowest elevation and working upslope.
- E. To prevent contamination of the base by soil at the sides of the excavation, cover the sides of the excavation with fabric and fasten it to the ground with metal staples while removing all wrinkles. Excess fabric and exposed staples can be removed once the job is completed.
- F. When a new section of fabric is placed it should overlap a minimum of 12 in. In weaker soils, it may be necessary to increase overlap to a minimum of 24 in. Consult manufacturer and/or soils engineer.

3.3 UNIT INSTALLATION

- A. First course of concrete wall units shall be placed on the base leveling pad. The units shall be checked for level and alignment.
- B. Ensure that units are in full contact with base.
- C. Units are placed side by side for full length of wall alignment. alignment may be done by means of a string line or offset from base line.
- D. Install fiberglass connecting pins and fill all voids at units with unit fill material.
- E. As appropriate where the wall changes elevation, units can be stepped with grade or turned into the embankment with a convex return end. Provide appropriate buried units on compacted leveling pad in area of convex return end.

3.4 CAP INSTALLATION

- A. Place cap units over projecting pins from units below.
- B. As required, provide permanent mechanical connection to wall units with construction adhesive. Apply adhesive to top surface of unit below and place cap unit into position.

3.5 BACKFILL PLACEMENT

- A. Unit fill shall be used for backfill adjacent to wall. Backfill shall be placed and compacted in lifts not to exceed 8 inches.
- B. Compaction requirements shall conform to Division 31 - Earthwork.
- C. At the end of each day's operation, the Contractor shall slope the last lift of backfill away from the wall units to direct runoff away from wall face.
- D. Only lightweight hand-operated equipment shall be allowed within 3 feet from the front face of the segmental concrete unit.

SECTION 32312 – FENCES AND GATES**PART 1 GENERAL****1.0 SECTION INCLUDES**

- A. Fences around trash enclosure and mechanical equipment.
- B. Decorative Fencing
- C. Security Fencing

1.1 RELATED SECTIONS

- A. Section 05500 - Metal Fabrications
- B. Section 06100 - Rough Carpentry
- C. Section 09900 - Painting

1.2 PROJECT CONDITIONS

- A. Do not install wood fencing until all site work, concrete work, and sodding are complete. The site should be relatively dry. Coordinate all work with the general contractor.

1.3 QUALITY ASSURANCE

- A. All work shall meet the requirements of all government codes, regulations and safety directives related to the work.

PART 2 PRODUCTS**2.0 MATERIALS FOR WOOD FENCES**

- A. All wood shall be either:
 - 1. Western Red Cedar (No. #1 or clear)
 - 2. Redwood (Basket weave fences)
 - 3. Treated Souther Yellow Pine - Yellawood
- B. All posts used in the construction of this fence shall be rough sawn 4" x 4" treated Souther Yellow Pine or as shown on the drawings.
- C. All framework (stringers) used in the construction of this fence shall be dimensional 2" x 4" per the following:
 - 1. 6' height or less, 2 stringers 6" or less from the top or bottom.
 - 2. 8' height or less, 3 stringers 6" or less from the to or bottom.
- D. All fence boards (pickets) shall be 1" x 6" nominal rough sawn lumber with height of pickets as shown on the drawings. Unless otherwise stated on the drawings, all pickets shall have clipped corners (dog-ear).
- E. Gate hardware, heavy duty as required, shall be black powder coated fittings as manufactured by American Hardware, Tulsa, Oklahoma, or approved equal.
- F. Gate posts shall be a minimum 6" diameter schedule 40 steel and concrete filled. Each post shall be equipped with a grease fitting for smooth operation of collared hinges.
- G. Framework for the gates shall be 2"x2"x3/16" steel angle with "X" bracing as indicated on the drawings.
- F. All nails and/or staples used in the construction of this fence shall be galvanized or aluminized. If galvanized nails are used to secure the pickets to the stringers, nails shall be 2" ring-shank nails. A metal bracket, such as Simpson "Strong-Tie" #A23 or equal, and a 16 penny common nail shall be used to attach the stringers to the posts.

2.1 MATERIALS FOR CHAIN LINK FENCES

- A. Fence shall be 7' high above grade, using 6' high chain link fabric.
- B. Chain link fabric shall be either aluminum coated conforming to ASTM-A491 or zinc coated conforming to ASTM-A392 Class 2. Fabric shall be woven from 9 gauge (coated size) with in 2" mech. Fabric 72" high and over shall be knuckled at each selvage.
- C. Line posts shall be 2-3/8" O. D. standard weight galvanized pipe with minimum bending strength of 210 pounds under a 6' cantilever load coated with 2.90 ounces of hot dipped zinc in accordance with ASTM-F1083.8.
- D. Top and brace rails shall be 1-5/8" O. D. standard weight galvanized pipe with minimum vertical bending strength of 202 pounds on 10' span coated with 2.0 ounces of hot dipped zinc in accordance with ASTM-F0183 (formerly ASTM-A120. A 3/8" diameter galvanized tress rod and fittings shall be installed diagonally between end, corner or pull post to line post. One end of the truss rod attachment to end, corner or pull post shall be approximately 1" above grade and the other end attached approximately 1' below top of line post. Top rail couplings 6" minimum in length shall be spaced at maximum 21' centers. Fabric tie wire shall be spaced at 24" maximum centers.
- E. All end, corner and pull posts shall be 2 7/8" O.D. galvanized standard weight pipe with minimum bending strength of 381 pounds on 6' cantilever load coated with 2.0 ounces of hot dipped zinc in accordance with ASTM-F0183 (Formerly ASTM-A120). Gate posts shall be of the following sizes for single swing gates or one leaf of double gates:

Leaf Width	Gate Post	Lbs/Lin. Ft.
Up to 6'	2-7/8" O.D. Pipe Sch. 40 Galv.	5.79
Over 6' to 13'	4" O.D. Pipe Sch. 40 Galv.	9.11
Over 13' to 18'	6-5/8" O.D. Pipe Sch. 40 Galv.	18.97
Over 18'	8-5/8" O.D. Pipe Sch. 40 Galv.	28.55

- F. Gate Frames shall be tubular shaped, 1.90" outside diameter with welded or steel fitted corners. Braces and trusses shall be furnished when necessary.
- G. All fittings shall be pressed steel or malleable iron and shall be hot dip galvanized conforming to ASTM-A152. The wires shall be minimum 9 gauge aluminum or 11 gauge galvanized steel.
- H. All material is subject to testing. Mill certificates shall be submitted upon request of owner.

PART 3 EXECUTION

3.0 INSTALLATION

- A. All posts shall be spaced at 8' on centers unless slope of line dictates otherwise, but then no more than 10' on centers.
- B. All posts shall be set in ready-mix concrete. Holes shall be a minimum of one foot in diameter or as shown on the drawings and to a depth below the minimum frost depth no less than 30 inches. All posts shall be embedded in concrete and crowned gently to shed water. The annular space in gate posts shall be filled with concrete.
- C. All framework shall be fastened to the posts using metal brackets.
 - 1. Pickets shall be secured to the stringer using one nail for every 2" of picket width.
 - 2. Board-on-board vertical fences shall be "shadow box" design with the spacing no more than 3 inches between boards.
 - 3. Basket weave fences shall have a minimum height of four feet.

3.1 CLEAN UP

- A. All soil removed from the holes shall be disposed of off site or in an area approved by the Owner's Representative.
- B. The removal of all scraps of lumber from the site shall be the responsibility of the fence contractor.

SECTION 32930 - LANDSCAPING**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. The General Requirements of these specifications apply to all landscape operations.

1.1 DESCRIPTION

- A. Provide trees, plants, and ground covers as shown and specified. The work includes:
 - 1. Soil preparation.
 - 2. Trees, plants, and ground covers.
 - 3. Planting mixes.
 - 4. Mulch and planting accessories.
 - 5. Existing plant relocation.
- B. Related work:
 - 1. Division 31: Earthwork.

1.2 QUALITY ASSURANCE

- A. Comply with all applicable local, state and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.
- B. Obtain and pay for all required inspections, permits, and fees. Provide notices required by governmental authorities.
- C. The General Contractor's project manager shall oversee the work and assure its adherence to the plans and these specifications. Henceforth, this person shall be designated as Owner's Representative.
- D. Plant names indicated, should comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Provide stock true to botanical name. Do not substitute without permission of Owner or Owners Representative.
- E. Comply with sizing and grading standards of the latest edition of "American Standard for Nursery Stock." A plant shall be dimensioned as it stands in its natural position.
 - 1. For plant material grown in fabric-ground containers, the following chart shall determine root mass size in relation to caliper:

Fabric-ground Suggested Container Diameter Caliper of Size Plant	
10" / 1"	
12" / 1"	
14" - 16" / 1 ½" - 2"	
18" - 20" / 2" - 3"	
22" - 24" / 3" - 4"	
- F. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project.
- G. Stock furnished shall be at least the minimum size indicated. Larger stock is acceptable, at no additional cost to owner. Root systems must meet AAN standards as specified. Plants should not be altered by pruning or other means to meet specifications.
- H. Provide "specimen" plants with a special height, shape or character of growth. Specimen trees or shrubs may be tagged at the source of supply. The Owner's Representative may inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, provide sufficient photographs of the proposed specimen plants for approval.
- I. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size and variety.

1.3 SUBMITTALS

- A. Submit the following material samples, if requested by Owner:
 - 1. Mulch -Bulk or Bagged.
 - 2. Decorative Stone or Gravel -Bag or Bulk
- B. Submit the following materials certification, if requested by Owner:
 - 1. Topsoil source and pH value.
 - 2. Peat moss, compost, or other organic soil amendments
 - 3. Plant fertilizer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer materials in original, unopened and undamaged containers showing weight, analysis, and name of manufacturer. Store all materials in a manner to prevent moisture and deterioration.
- B. Take all precautions customary in good nursery practice to prepare plants for transport. Workmanship, which fails to meet the highest standards, will be rejected. Spray deciduous plants in foliage with an approved Anti-Desiccant immediately before digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury.
- C. Cover plants transported on open vehicles with a protective covering to prevent windburn.
- D. Deliver plant materials properly labeled for identification and store in shade protected from weather.
- E. Time delivery of sod so that placement occurs within 24 hours after stripping. Protect against drying and breaking of rolled strips.
- F. Plant material shall be planted immediately upon delivery. No plant shall be bound with rope or wire in a manner that would damage the bark or break the branches.

1.5 PROJECT CONDITIONS

- A. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Contact utility companies before digging. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations at Contractor's expense.
- B. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.
- C. Locate, protect, and maintain benchmarks, monuments, control points and project engineering reference points. Re-establish disturbed or destroyed items at Contractor's expense.
- D. Obtain governing authorities written permission when required to close or obstruct street, walks and adjacent facilities. Provide alternate routes around closed or obstructed traffic ways when required by governing authorities.
- E. Control dust caused by the work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.
- F. Protect existing buildings, paving, and other services or facilities on site and adjacent to the site from damage caused by work operations. Cost of repair and restoration of damaged items at Contractor's expense.
- G. Protect and maintain streetlights, utility poles and services, traffic signal control boxes, curb boxes, valves and other services, except items designated for removal. Remove or coordinate the removal of traffic signs, parking meters and postal mailboxes with the applicable governmental agency.
- H. Work notification: Notify Owner's Representative at least five (5) working days prior to installation of plant material.

- I. Protect existing improvements, paving, utilities and other facilities from damage caused by landscaping operations.
- J. A complete list of plants, including a schedule of sizes, quantities, and other requirements is shown on the drawings.

1.6 WARRANTY

- A. Warrant plant material and lawns to remain alive and be in a healthy, vigorous condition for a period of one (1) year after acceptance, provided plants are given proper care during this period.
 - 1. Contractor to call for final inspection of plants.
- B. Remove and immediately replace all plants, as determined by the Owner's Representative, to be unsatisfactory during the initial planting installation.
- C. Replace all plants that are dead or, as determined by Owner's Representative, are in a severely unhealthy condition within warranty period. Replacement plants shall be installed at next best planting season.
- D. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, drought, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting areas; acts of vandalism or negligence on the part of the Owner. Any replacement attributed to these causes must be in addition to the contract amount.

PART 2 PRODUCTS

2.0 PLANT MATERIALS

- A. Plant Materials: Plant materials shall conform to the type and size indicated on the Drawings and shall be sound, healthy, vigorous, and free from plant diseases and insect pests and their eggs, and shall have normal, healthy root systems. Measurements, such as spread, ball size, number of canes, quality designations, etc., shall be in accordance with the latest edition of "American Standards for Nursery Stock."
 - 1. Substitutions will not be permitted without prior approval by Owner.
 - 2. Plants designated "BB" in the Plant List shall be balled and burlapped. They shall be dug with firm natural balls of earth of sufficient depth and radius to encompass the fibrous and feeding root systems necessary for the full recovery of the plant. Balls shall be securely wrapped with burlap and bound with cord. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock." Cracked or mushroomed balls are not acceptable.
 - 3. Container-grown stock shall have grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.
 - a. No plants shall be loose in the container.
 - b. Container stock shall not be pot bound.
 - 4. If the use of larger than specified plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.
 - 5. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size and variety designated in the plant list and according to the AAN Standards for Nursery Stock.
 - 6. Shrubs and small plants shall meet the requirements for spread and/or height indicated in the plant list and be in accordance with AAN standards.
- B. Commercial Fertilizer: Shall be uniform in composition, free flowing and suitable for application specified, and containing nitrogen, phosphorous, and potassium in percentages by weight indicated in this Specification and plan notes.
- C. Weed Killer: Type recommended by State Agriculture Department.
- D. Planting Mixture: The material which is used for tamping around the balls and roots in the process of planting shall be a soil mixture as indicated on the Drawings.
- E. Mulch:

1. Wood Chip Mulch: Shredded hardwood bark.
2. Gravel Mulch: 3/4 inch crushed buff color limestone rock as noted in the plan notes.
- F. Edging (if applicable): Valley View 'Black Diamond' edging. Install per manufacturer's specifications.
- G. Topsoil: Friable clay loam surface soil found in a depth of not less than 4", free of or reasonably free of subsoil clay lumps stones and other objects over 2" in diameter, and without weeds, roots and other extraneous and toxic matter harmful to plant growth.
 1. Topsoil has been (or will be) stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.
 2. Topsoil for landscape work is not available at site and must be furnished as specified.
 3. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at Project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4"; do not obtain from bogs or marshes.

2.1 LAWN MATERIALS

- A. Sod: Sod shall be mixed Kentucky Bluegrass or a Tall Turf-Type fescue common to the locality, free of pernicious weeds and conforming with Local/State Specifications. Weed content shall not be over 0.30 of 1 percent. It shall be mowed to a height of not less than 1 1/2" before lifting and shall be of uniform thickness with not less than 1" of soil.
 2. Cellion fiber mulch or equal.
- B. Fertilizer:
 1. Granular, non-burning product composed of not less than 50% organic, slow acting, guaranteed analysis professional fertilizer.
 2. Starter fertilizer containing 10% nitrogen, 10% phosphoric acid, and 10% potash by weight, or similar approved composition.

2.2 ACCESSORIES

- A. Water: Hoses or other methods of transportation furnished by Contractor. Note: Contractor may need to truck water to site if not yet available.
- B. Stakes for staking: Hardwood, 2" x 2" (6-8') long (2x4 pine is permissible).
- C. Stakes for guying: Hardwood, 2" x 2" x 24" long.
- D. Guying/staking wire: 12- or 14-gauge galvanized wire.
 1. Turnbuckles: Galvanized steel of size and gauge required to provide tensile strength equal to that of the wire. Turnbuckle openings shall be at least 3".
- E. Staking and guying hose: Two-ply, reinforced garden hose not less than 1/2" inside diameter. Shall be uniform in color.
- F. Plastic guy material no less than 1/4". Shall be uniform in color and level as applied.
- G. Twine: Two-ply jute material.
- H. Weed control barrier: Rot resistant polypropylene fabric or equivalent, water and air permeable.

PART 3 EXECUTION

3.0 EXAMINATION

- A. Examine the soils, surrounding construction and the conditions under which landscaping work is to be performed, and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. Time of planting:
 - 1. Evergreen material: Plant evergreen materials between September 1 and December 1 or in spring before new growth begins. If Owner requires planting at other times, plants shall be sprayed with anti-desiccant prior to digging operations, weather dependent.
 - 2. Deciduous material: Plant deciduous materials in a dormant condition. If deciduous trees are planted in- leaf, they shall be sprayed with an anti-desiccant prior to digging operation.
- B. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.
- C. Locate plants as indicated on drawings. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until Owner's Representative has selected alternate plant locations.
- D. Excavate circular plant pits with vertical sides, except for plants specifically indicated to be planted in beds. Provide shrub pits at least twice as wide as the root system and 24" greater for trees. Depth of pit shall be no greater than the root ball depth. Scarify bottom of the pit. Remove excess excavated materials from the site.
- E. Provide pre-mixed ground cover bed planting mixture for use around the balls and roots of the plants consisting of five (5) parts existing soil to one (1) part peat moss and 1lb. plant fertilizer for each cubic yard of mixture or equivalent. Bagged bark professional mixes are an equivalent substitute for peat moss.
- F. Provide pre-mixed ground cover bed planting mixture consisting of three (3) parts existing soil to one (1) part peat moss and 1lb. plant fertilizer per cubic yard. Provide beds a minimum of 6" deep. Bagged bark professional mixes are an equivalent substitute for peat moss.
- G. Loosen topsoil of lawn areas to minimum depth of 3", if compacted. Remove stones over 1" in any dimension, sticks, roots, rubbish, and extraneous matter.
- H. Apply lime to lawn areas at a rate to adjust pH of topsoil to not less than 5.5 nor more than 6.8. Distributed evenly by machine and incorporate thoroughly into topsoil.
- I. Apply fertilizer to indicated turf areas at a rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. (220 lbs./acre).
- J. Grade lawn areas to a smooth, free-draining, even surface with a loose, moderately coarse texture.
- K. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to sodding.

3.2 PRE-PLANTING

- A. Pre-planting.
 - 1. Plants shall be brought to the site the day they are to be installed, if possible. If situations arise where earlier delivery can't be avoided or if planting is delayed after the plants have been delivered, they shall be stored where they can be properly watered, sheltered from direct sunlight, and protected from mechanical damage by construction equipment, animals, etc. If storage needs to be more than two days, the plants shall be separated far enough from each other to provide good air circulation to their tops, reducing the risk of fungus. Bare root plants which must be held shall be healed-in where they can be watered as needed.
 - 2. All plants shall be watered thoroughly and allowed to drain prior to planting.
 - 3. While planting, bare root plants must be protected from hot sun and drying wind by shading them with burlap, landscape fabric, straw or other breathable material. Plastic is unacceptable. Containerized plants must be left in their containers until each is planted. They shall not be removed from the containers to be laid out on the bed where sun and wind will damage the roots prior to planting.
 - 4. Any dead or damaged plant parts shall be removed from the plants upon planting.

- B. Mulching is an option which may be specified for artistic reasons, water conservation, weed control or erosion control. Where mulching is specified, the mulch must be pulled away from the stems and crowns of herbaceous perennials to reduce the occurrence of rot or rodent damage. Mulch thickness should be 2 inches or less.

1. Weed control barrier: Install filter fabric prior to Mulch beds.

3.3 FINISH GRADING

- A. Over subgrade in lawn areas place topsoil to a minimum depth of 4". Topsoil shall be free from gravel, rocks, weeds, roots, etc. No mulch and black sand shall be used.
- B. Spread topsoil evenly over lawn areas to be sodded. The finish surface shall be smooth and true to contours as indicated. Bring to elevation as required to allow installation of sod. Grades shall slope away from building at all points.
- C. Topsoil shall not be placed when the sub-grade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to planting and proper grading.

3.4 SODDING

- A. Fine rake topsoil to break up lumps and to remove foreign material.
- B. 10-10-10 fertilizer shall be spread evenly with a mechanical spreader at the rate of 20 lbs. per 1000 s.f. and thoroughly incorporated into the topsoil to a depth of 2". The surface shall then be re-compacted.
- C. Inequities and soft spots shall be corrected before the sod is laid. Sod shall be laid solidly with joints staggered so that no voids occur between the strips. Weeded roots, if any, must be removed before the sod is laid. Sod shall be tamped or rolled immediately after it is laid, and the finished surface shall be true to grade, and shall be smooth, even and equally firm at all points.
- D. Sodded areas shall be kept moist for the maintenance period. After the sod is installed, areas which fail to show a uniform stand of grass shall be re-sodded.

3.5 PLANTING

- A. Pits for trees and shrubs shall be excavated as part of this work. Subsoil dug from pits, trenches and beds shall be disposed of by the Subcontractor.
- B. The Subcontractor is responsible for planting to correct grades and alignment and plants shall be set so that, when settled, they will bear the same relation to finish grade as they did before being transplanted. No filling will be permitted around trunks and stems. Cut and remove wire baskets from roof balls upon final placement of trees.
- C. Plant pits shall be thoroughly soaked before planting. When the plant has been properly set, the pit shall be backfilled with planting mixture, gradually filling, tamping and settling with water. No soil in a frozen or muddy condition shall be used for backfilling. A ring of soil shall be formed around the edge of each plant to hold water. After each watering beds shall be raked and left in complete and finished manner.
- D. Planting shall be mulched with a cover of mulch.
 1. Install approved filter fabric directly below mulched plant beds, lapping edges and ends 3" minimum, allowing no gaps in coverage.
 2. Install 4 inch depth mulch under all trees, shrubs, and ground cover massings unless otherwise shown on Drawings.
- E. Upon completion of planting, trees and shrubs shall have been pruned and injuries repaired. The amount of pruning shall be limited to the minimum necessary to remove dead and injured twigs and branches and to compensate for the loss of roots from transplanting. Pruning shall be done in such a manner as not to change the natural habit and shape of the plant. Cuts shall be made flush leaving no stubs.
- F. Guying and staking is optional. (Guying trees 3" and over in caliper and stake trees under 3" in caliper. Maintain guys and stakes until the end of the guarantee period.) The

trunks of deciduous trees shall be wrapped with standard tree wrap from the ground up to the first branch with 50 percent overlap.

- G. If shown on drawings, install Valley View edging to contain shrub massing where planting beds meet sod.

3.6 ADJUSTING

- A. Inspection of the planting will be made jointly by the Subcontractor and Owner's Representative at the completion of planting. Plants which are not in a healthy, growing condition shall be removed and replaced with plants of like kind, size and quality as originally specified before the close of the next planting season.
 - 1. Replace dead and dying plants with original plant and planting mixture during guarantee period at no cost to Owner.
 - a. Replacement plants shall be warranted and maintained for an additional period of 1 (one) year. Warranty is limited to 1 (one) replacement per plant. Replacement stock shall meet Specifications and quality of original stock.
 - 2. Repair damage to lawns and other plants during replacement at no cost to Owner.
- B. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.
- C. Tighten and repair guy wires and stakes as required
- D. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.
- E. Water trees, plants and ground cover beds prior to acceptance by Owner.
- F. The beds should be checked regularly for soil settling which may expose the root balls or otherwise endanger the health of the planting. Should this occur, the contractor shall correct the settled areas
- G. Should insects or diseases attack the plants after installation and prior to acceptance of the planting, appropriate pesticides shall be properly applied.
- H. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of construction vehicles, and existing lawn areas as indicated.
- I. Provide fertilizer, seed and soil amendments as specified for new lawns and as required to provide a satisfactorily reconditioned lawn. Provide topsoil as required to fill low areas and meet new finished grades.
- J. Remove diseased or unsatisfactory lawn areas. Do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, stone, gravel, and other construction materials.
- K. Thin lawn areas shall be cultivated and re-seeded.

3.7 MAINTENANCE

- A. Plantings and turf areas shall be maintained by this Subcontractor for a period of 30 days after acceptance. Maintenance shall include necessary watering, weeding, mowing and spraying, to assure healthy vigorous growth.

3.8 PROTECTION OF WORK

- A. Occupancy of the Project shall not relieve the Subcontractor of any of the obligations outlined in these Specifications.
- B. Landscaped areas shall be protected by the Subcontractor against traffic damage, erosion, or other use by erecting barricades or temporary fencing immediately after planting is completed. These barricades, or temporary fencing, and signs shall be maintained until the lawns are well established.
- C. Upon final acceptance of the Work specified herein the Subcontractor shall remove barricades or temporary fences, unless otherwise directed.

- D. At the end of the warranty period, the Subcontractor shall remove guying, staking, wrapping, and saucers from the site.

3.9 ACCEPTANCE

- A. Planted areas will be inspected at completion of installation and accepted subject to compliance with specified materials and installation requirements.
 - 1. Planted areas will be accepted provided all requirements have been complied with and plant materials and lawn areas are alive and in a healthy, vigorous condition.
- B. The beds shall be free of weeds at planting time and shall be maintained weed free by the contractor until the planting is accepted by the client.

3.10 CLEANING

- A. Perform cleaning during installation and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from planting, or sod.
- B. Pressure wash driveways, sidewalks, curbs, etc. free of all dirt and residue.

SECTION 32950: IRRIGATION SYSTEMS**PART 1 GENERAL****1.0 SECTION INCLUDES**

- A. Design and complete underground sprinkler system as specified herein.
- B. Furnish and install piping and fittings, valves, quick coupling valves, sprinkler heads, controllers and all miscellaneous fittings, accessories, and all equipment needed.
- C. Maintenance Service: Irrigation Subcontractor shall provide the following services after the installation and acceptance by the Owner:
 - 1. Perform 1 (one) Fall system winterization.
 - 2. Perform 1 (one) Spring system start-up.
 - 3. Work required within the one year corrective period from the date of acceptance letter or notice by the Owner, shall be the irrigation system subcontractors responsibility.

1.1 RELATED SECTIONS

- A. Section 32900 - Landscaping
- B. Division 22 - Plumbing
- C. Division 26 - Electrical

1.2 SUBMITTALS

- A. Submit the following in accordance with General Requirements:
 - 1. Manufacturer's Literature: Materials description, installation, operating and maintenance instructions.
 - 2. Shop Drawings: Complete system design with each component identified.

1.3 QUALITY ASSURANCE

- A. All work shall be installed according to applicable codes and ordinances of the city and National Electrical Code. Permits required shall be obtained and paid for by the Irrigation Subcontractor.
- B. The work of this section shall be done by a firm regularly engaged in, and specializing in this work, with a minimum of 5 years experience in the type of work shown and specified.
- C. Entire irrigation system shall be coordinated with the Landscape Subcontractor.

PART 2 PRODUCTS**2.0 ACCEPTABLE MANUFACTURERS**

- A. Rain Bird Sprinkler Mfg. Corp.
- B. Toro Company

PART 3 EXECUTION**3.0 EXAMINATION**

- A. Examine the areas and conditions under which underground sprinkler system is to be installed and notify Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.1 PREPARATION

- A. The Irrigation Subcontractor is responsible for locating underground obstacles. It is not represented that the Drawings show all sewers, water lines, gas lines, telephone lines and other underground obstacles. Exercise caution to prevent damage to existing facilities during the progress of the construction work, taking care to locate same, where possible, in advance of the actual work. The Irrigation Subcontractor shall make good all damage to existing utilities resulting from his operations.

3.2 SERVICE

- A. Plumbing Subcontractor shall provide:
 - 1. Appropriate size Type K copper line (stub out) to 6 " outside of the building. Coordinate location with Irrigation Subcontractor.
 - 2. Separate meter and vacuum breaker or a deduct meter if acceptable to utility company.
 - 3. 120 Volt electrical current shall be provided to a junction box adjacent to the controller by the Electrical Subcontractor.

3.3 EXCAVATION AND BACKFILL

- A. All pipe lines shall be installed in the locations and of sizes indicated on the final Shop Drawings. Piping shall be laid accurately to line and grade.
- B. Install Class 200 PVC pipe sleeves under drives and sidewalks and extend 12" (minimum) beyond the edge of such construction.
 - 1. Coordinate irrigation sleeve installation with General Contractor.
 - 2. Sleeves shall be sized and placed appropriately to accommodate irrigation system piping.
- C. Interior of piping shall be kept clear of foreign matter before installation and shall be kept clean by means of plugging or capping ends after placement in trenches.
- D. Minimum depth of cover shall be at least 10" for the main and lateral lines.
- E. Provide 3/4" brass valve inside the building to winterize the system by the blowout method.

3.4 AUTOMATIC CONTROLLER

- A. Automatic controller shall be the type and model for the use intended and shall include at least the following features:
 - 1. 0-90 minute variable station timing.
 - 2. 14 day programmable.
 - 3. 24 hour clock.
 - 4. Automatic/manual switch.
 - 5. Rapid advance.
 - 6. Fuse protection.
- B. All 120 volt and control wires shall be placed in conduit. Arrangement of the controller and conduit shall be beneath in appearance and adjacent to the wall. All electrical wires shall be installed in accordance with city, state, and national codes.
- C. Number of stations to be determined by manufacturer.

3.5 CONTROL WIRE INSTALLATION

- A. All electric wire shall be installed in the pipe trenches whenever possible. Wire shall be placed underneath the pipe.
- B. Wire shall be bundled together every 20' with electrical tape. Expansion joints in the wire shall be provided by making a 12" loose coil.

- C. All control or hot wire shall be of one color (black) and all common or ground wire shall be of another color (white).
- D. Wire connections to control valves and splices shall be made using "Moistite" wire connectors and potting compound.
- E. All wire connections at control valves and splices shall be left with sufficient slack so that in case of repair the valve bonnet or splice may be brought to the surface without disconnecting the wires.

3.6 VALVES AND SPRINKLER HEADS

- A. The sprinkler heads shall be fixed spray or gear driven rotary. All sprinkler heads and quick coupling valves shall be set perpendicular to finish grades unless otherwise specified.
- B. Sprinkler heads adjacent to walls, curbs or other paved areas shall be set to grade.
- C. Install all new valves as may be required for the proper control of the piping systems in which they are incorporated.

3.7 VALVE BOX INSTALLATION

- A. All remote control valves or gate valves shall be installed in a valve box.
- B. All valve boxes shall be installed on a suitable base for proper foundation of box and easy leveling of box to proper grade. All valve boxes shall be provided with proper length and size extension to bring the valve box level with the finish grade and so the bottom of the valve box is a minimum of 2" below the bottom of the valve.
- C. The interior of the valve boxes shall be left free of dirt and debris and the entire length of the pipe and valve in the valve box shall be free and clean and level with the bottom of the valve box.
- D. If the holes where pipe enters the valve box are excessively large so that dirt will fall in around the pipe, plug the hole with leak proof material.
- E. Location of irrigation system heads, piping and valves shall be marked to avoid damage during completion of the landscaping work.

3.8 FIELD QUALITY CONTROL

- A. When the main line or sections of the main line, laterals, swing joints and valves have been installed, the system (or section) will be thoroughly flushed. The system (or section) will then be pressurized by means of a hydrostatic test at 120 psi. The test period shall be for 2 hours.

3.9 CLEANING AND FLUSHING SYSTEM

- A. After pipe, fittings, and valves have been installed and connections made to the water source, flush pipes several times until free from all rocks, dirt, trash, pipe shavings, or debris before installing heads. After the pipe has been thoroughly flushed start installing the heads with the water running, beginning with the one nearest the valve and working towards the ends of the laterals forcing the water and any debris left in the pipe out the last head connection. After the heads have been installed, the system is to be used several times before final inspection. The heads shall be cleaned or replaced if necessary before final inspection.

3.10 ADJUSTING AND CLEANING

- A. The Irrigation Subcontractor shall make final cleanup of all parts of the work before final acceptance. This cleanup shall include removal of all construction materials and equipment, and in general preparing of the site in an orderly and finished appearance.

- B. Remove from the site, rock and extra dirt resulting from the performance of this work and restore the site to its appearance prior to beginning irrigation work.

3.11 SERVICES OF IRRIGATION SUBCONTRACTOR

- A. The Irrigation Subcontractor shall school at least 2 of the employees, who will be maintaining the irrigation system, in operating and maintaining the system, This will include the operation of the controllers and valves, how to most effectively use the system, maintenance on all equipment including removal and replacement of valve and controller components.

3.12 EXTRA PARTS AND PARTS LIST

- A. Provide 2 copies of the parts list and manufacturer 5 catalog showing performance, weight, quality and functions of each item of equipment installed.

SECTION 33310 – DRAINAGE PIPE AND FITTINGS FOR SEWERS**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 RELATED WORK

- A. Section 31000 - Earthwork
- B. Section 31231 – Rock Removal
- C. Section 33462 – Geotextile Subsurface Drainage Filtration
- D. Section 33391 – Manholes, Frames and Covers for Sewers
- E. Geotechnical Soils Report (if available)

1.2 SUMMARY

- A. The Contractor shall furnish all labor, material, and equipment necessary to install gravity sewer piping together with all appurtenances as shown and detailed on the Drawings and specified herein.

1.02 SUBMITTALS

- A. Product Data (if requested by Owner): Manufacturer's data including dimensions and strength information.

PART 2 PRODUCTS**2.0 DUCTILE IRON PIPE AND FITTINGS**

- A. Ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) and ANSI A21.51 (AWWA C151). The pipe shall be designed for an internal working pressure of 150 psi and external loading based on flat bottom trenches without blocks and untamped backfill laying conditions. The pipe shall conform to the following minimum thickness classes: pipe size 4 inches and smaller, Class 51; pipe size 6 inches and larger, Class 50.
- B. Fittings shall be Class 250 ductile iron fittings in accordance with ANSI A 21.10 (AWWA C 110).
- C. Joints shall be push-on type, mechanical joint type conforming to ANSI A21.11 (AWWA C 111) or restrained joint type. Unless specifically required at designated locations by the Drawings, the type of joint used is optional. Restrained joints shall be TR-Flex type as manufactured by U.S. Pipe and Foundry Co., or approved equal.
 - 1. Push on joints shall have an annular recess in the pipe socket to accommodate a single rubber gasket. Plain ends shall be suitably beveled to permit easy entry into the bell. The gasket and annular recess of the socket shall be so designed and shaped that the gasket is located in place against displacement as the joint is assembled.
 - 2. Mechanical joints shall be bolted and of the stuffing box type and shall consist of a bell with exterior flange and interior recess for the sealing gasket, a pipe or fitting plain end, a sealing gasket, a follower gland, tee-head bolts and hexagon nuts.
 - 3. Restrained joints for a 4" through 54" push-on joint pipe installation is required and indicated in the project plans or specifications, restrained push-on joint pipe and fittings utilizing ductile iron components shall be provided.
 - a. Restrained joint pipe shall be ductile iron manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51. Push-on joints for such pipe shall be in accordance with ANSI/AWWA C111/A21.11. Pipe thickness shall be designed in accordance with ANSI/AWWA C15-/A21.50, and shall be based on laying conditions and internal pressures as stated in the project plans and specifications. Pipe shall be U.S. Pipe TR FLEX pipe or equal.

- b. Restrained joint fittings shall be ductile iron in accordance with applicable requirements of ANSI/AWWA C110/A21.10 with the exception of the manufacturer's proprietary design dimensions. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11. Fittings shall be U.S. Pipe TR FLEX fittings or equal.
- c. Cement mortar lining and seal coating for pipe and fittings, where applicable, shall be in accordance with ANSI/AWWA C104/A21.4. Bituminous outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.
- d. Restrained push-on joints for pipe and fittings shall be designed for a water working pressure of 350 psi in sizes 4" through 24" and 250 psi for sizes 30" through 54".
- e. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.
- 4. All ductile iron pipe and fittings shall have the manufacturer's outside coal tar or asphaltic base coating and a polyethylene lining complying with ANSI/ASTM D1248 on the inside.
- D. The inside lining material for pipe and fittings shall be virgin polyethylene complying with ANSI/ASTM D1248, compounded with an inert filler and with sufficient carbon black to resist ultra-violet rays during above ground storage of the pipe and fittings. The polyethylene shall be bonded to the interior of the pipe of fitting by heat.
 - 1. All surface areas to be lined shall be blast cleaned comparable to the requirements of SSPC-SP6 or NACE #3.
 - 2. Polyethylene linings shall cover the inner surface of pipe and fittings as shown and described below. In pipe utilizing push-on gaskets, the lining shall extend from the spigot end through the socket to the edge of the gasket sealing area. In mechanical joint pipe the lining shall extend from the spigot end through the socket to the edge of the gauging ring. The lining in fittings shall cover the interior surfaces including the socket areas as defined above.
 - 3. Lining in piping and in the fittings shall be 40 mils nominal thickness. Minimum lining thickness shall be 30 mils.
- E. Pipe shall be furnished in lengths of 16, 16.5, 18 and 20 feet nominal laying lengths. The weight of any single pipe shall not be less than the tabulated weight by more than 5 percent for pipe 12 inches or smaller in diameter, not by more than 4 percent for pipe larger than 12 inches in diameter.
- F. The net weight, class, or nominal thickness and sampling period shall be marked on each pipe. The pipe shall also be marked to show that it is ductile iron.

2.1 PIPE JOINTING FOR DUCTILE IRON PIPE

- A. Mechanical Joint:
 - 1. Mechanical joints are to be furnished according to AWWA Specifications C111. All pipe joints must be furnished complete with all accessories. Mechanical joint bolts and nuts shall be of alloy cast iron (such as Acipcoloy) or alloy steel (Corten type such as US alloy) or approved equal. Rubber gaskets shall be made of plain first grade rubber, free of imperfections and porosity. Hardness shall be 70 to 75 durometer.
 - 2. Mechanical joints shall be used where specifically called for on the Drawings.
 - 3. Push-in socket joints shall be equal to manufacturer's specifications for "Tyton," "Bell-Tite", or "Fastite".

The joints shall consist of a rubber ring gasket compressed in groove in bell of pipe with beveled pigot end of pipe for initial centering into rubber gasket in bell.
 - 4. All items used for jointing pipe shall be furnished with the pipe and tested before shipment. The joints shall be made with tools and lubricant in strict conformity with the manufacturer's instructions. If requested, three (3) copies of such instructions shall be delivered to the Engineer at start of construction.

2.2 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER:

- A. Polyvinyl chloride (PVC) pipe and fittings, 4 to 15 inch in diameter, for gravity sewers shall conform to the requirements of ASTM specification D-3034 (SDR 35), current approval, "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings."
- B. Polyvinyl chloride (PVC) pipe and fittings, 18 inch to 24 inch in diameter shall conform to the requirements of ASTM specification F679, current approval.
- C. Joints for PVC pipe shall be of the elastomeric gasket type and installed per the manufacturer's recommendations. Pipe that has been field cut must be beveled for insertion into gasketed joints. Bevel can be made with hand or power tool. In either case, the finished bevel should be the same as the factory bevel. All pipe shall be provided with home marks to insure proper gasket seating. Gasket material shall comply with the physical requirements specified in ASTM D-1869, C-361, C-433, current approval.
- D. Fittings for service connections shall be of the factory made inline type conforming with the requirements of ASTM specification D-3034, current approval. Saddle type fittings shall not be used.
- E. PVC sewer pipe shall be supplied in standard lengths of at least 12'6". Longer lengths are permitted.
- F. PVC sewer pipe shall be marked with the manufacturer's name, production lot number, ASTM designation, PVC, and the nominal diameter.
- G. All underground place piping shall have a metallic tape laid 2 feet above the pipe. The tape shall have the word "Caution" printed on it and shall identify the pipe use. Product shall be Seton Name Plate Corp., New Haven, Connecticut, No. 210, or equal.
- H. Five copies of directions for handling and installing shall be furnished the Contractor for the manufacturer at the first delivery of the pipe to the job.

2.3 PIPE JOINTING FOR PVC PIPE

- A. Polyethylene Pipe Joints: Jointing of polyethylene pipe shall be by the butt fusion method and shall be performed in strict conformance to the pipe manufacturer's recommendations using approved equipment. Fittings shall be connected with stainless steel couplings if fusion is not possible.
- B. Where used in highway crossing, the Contractor shall take precautions to insure no damage to the pipe when placing it in the casing

2.4 POLYVINYL CHLORIDE (PVC) FORCE MAIN:

- A. PVC pipe shall comply with ASTM D1784 and shall be Class 200 (SDR 21) as shown on the Drawings. All PVC pipe shall conform to the latest revisions of the following specifications:
 - 1. ASTM D2241 (PVC plastic pipe SDR-PR and Class T).
 - 2. Commercial Standard CS 256 (pressure rated type).
 - 3. National Sanitation Foundation Testing Laboratories (NSF).
- B. The name of the manufacturer of the plastic pipe to be used must be found on the current listing of Plastic Materials for Potable Water Application, published by the NSF (National Sanitation Foundation), Ann Arbor, Michigan, and must meet the requirements of the Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, D1784, published by ASTM (American Society for Testing and Materials). Rubber gasketing shall conform to ASTM 1869.
- C. Pipe lengths shall not exceed 40 feet. Wall thickness shall exceed 40 feet. Wall thickness shall be in accordance with CS-256 and ASTM D2241. Pipe ends shall be beveled to accept the gasketed coupling.
- D. Samples of pipe, physical and chemical data sheets shall be submitted to the Engineer for approval, and his approval shall be obtained before pipe is purchased.
- E. The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. The pipe shall be as uniform as commercially practical in color.
- F. Pipe shall have a ring painted around spigot ends in such a manner as to allow field checking of setting depth of pipe in the socket.
- G. Pipe must be delivered to the job site by means which will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported that the bottom rows of pipe are

not damaged by crushing. Pipe shall be unloaded carefully and strung or stored as close to the final point of placement as is practical.

- H. The couplings and fittings shall be furnished by the pipe manufacturer and shall accommodate the pipe for which they are to be used. They shall have a minimum pressure rating of 200 psi (SDR 21). Insertion depth of the pipe in the coupling shall be controlled by an internal PVC mechanical stop in the coupling which will allow for a thermal expansion and contraction. Coupling method shall allow for half of the expansion or contraction of each pipe section to be taken up at each end of the pipe. Couplings shall permit 5 degree deflection (2 1/2 degree each side) of the pipe without any evidence of infiltration, exfiltration, cracking or breaking. Couplings shall have rubber seals factory installed.
- I. Pipe markings shall include the following, marked continuously down the length:
 - 1. Manufacturer's name.
 - 2. Nominal size.
 - 3. Class pressure rating.
 - 4. PVC 1120.
 - 5. NSF Logo.
 - 6. Identification Code.
- J. Lubricant shall be water soluble, non-toxic, be non-objectionable in taste and odor imparted to the fluid, non-supporting of bacteria growth, and have no deteriorating effect on the PVC or rubber gaskets.
- K. All underground plastic piping shall have a colored metallic tape laid 2 feet above the pipe. The tape shall have the words "caution" printed on it and shall identify the pipe use. Use Seton Name Plate Corp., New Haven, Connecticut, No. 210 or equal.

2.5 CONCRETE PIPE

- A. Reinforced Concrete Pipe: DOT Section 706-02, Class
- B. Furnish pipe of the strength given in the table below. Use standard strength pipe unless extra strength is indicated.

PIPE STRENGTH (Lbs/Lin Foot - ASTM Three-Edge Bearing Method)		
PIPE SIZE (INCHES)	STANDARD STRENGTH	EXTRA STRENGTH
4	1500	2000
6	1500	2400
8	1500	2400
10	1600	2400
12	1800	2600
15	2000	2900
18	2200	3300
21	2400	3850
24	2600	4400

2.6 BITUMINOUS COATED CORRUGATED STEEL PIPE

- A. Corrugated Steel Pipe, Round or Arch: Conform to DOT Section 707-02 except as herein amended.
 - 1. Coat uniformly with bituminous material inside and out with a minimum thickness of 0.05 inches. Apply additional bituminous material by centrifugal methods forming a smooth lining on the interior of the pipe, filling the corrugations and having a minimum thickness of 1/8 inch above the crest of the corrugations.
 - 2. The interior surface of the pipe shall have a coefficient of roughness of not greater than 0.013 (Manning).
 - 3. Gage of round pipe shall be not less than:

DIAMETER	GAGE
6 - 24 inches	16
30 -36 inches	14
42 -60 inches	12

4. Joint Couplings: Galvanized steel sleeve couplings coated to match the pipe.
Headwalls and End Sections: DOT, Section 707-10.

2.7 POLYETHYLENE CORRUGATED PIPE & FITTINGS

- A. Manufacturer's:
 1. Advanced Drainage Systems, Inc., 3300 Riverside Dr., Columbus, OH 43221; (614) 457-3051.
 2. Hancor, Inc., 401 Olive St., Findlay, OH 45840; (800) 847-5880.
- B. Corrugated Polyethylene Pipe and Fittings: Conform to AASHTO M-252 (4 to 10-inch diameter) or AASHTO M-294 (12 to 36-inch diameter).
 1. Coefficient of Roughness (interior pipe surface): 0.020 maximum (Manning formula).
 2. Classification: Type C.
 3. Design Strength (all sizes): 50 feet allowable height of cover.
 4. Joint Couplings: Polyethylene Couplers; snap-on type or split collar through 24-inch diameter, screw-on type where applicable.
 5. Material Properties: High-density polyethylene meeting the requirements of ASTM D 3350, Cell Classification 324420C; or ASTM 1248, Type III, Class C, Category 4, Grade P33.
- C. Corrugated Polyethylene Pipe (Smooth Interior): Conform to AASHTO M-294 (12 to 36-inch diameter).
 1. Coefficient of Roughness (interior pipe surface): 0.012 maximum (Manning formula).
 2. Classification: Type S.
 3. Minimum Pipe Stiffness Values:

DIAMETER	PIPE STIFFNESS (PER ASTM D 2412)
4", 6", 8", 10", 12"	50 psi
15"	42 psi
18"	40 psi
24"	34 psi
30"	28 psi
36"	22 psi

4. Joint Couplings: Polyethylene Couplers; snap-on type or split collar through 24-inch diameter, screw-on type where applicable.
 - a. Corrugated to match pipe corrugations, width not less than one half pipe diameter.
 - b. Split couplings shall engage an equal number of corrugations on each side of the joint.
5. Joint Couplings: Polyethylene, bell-and-spigot type couplers utilizing an elastomeric gasket conforming to ASTM F 477.
- D. Fittings:
 1. High density polyethylene meeting the properties specified for the pipe.
 2. Either molded or fabricated.
 3. Designed specifically for the pipe furnished and manufactured by the pipe manufacturer.
- E. Headwalls and End Sections: Galvanized steel manufactured from material meeting the requirements of AASHTO M-218.
 1. Conform to shape, dimensions, and thickness shown on the drawings.
 2. Use only extra length rod and lug-type, galvanized coupling band connectors.
- F. Perforated Pipe: Conform to AASHTO M-252 or AASHTO M-294, Type SP with Class I perforations.

PART 3 EXECUTION**3.0 SHORING, SHEETING, AND BRACING OF EXCAVATION**

- A. Where unstable material is encountered or where the depth of excavation in earth exceeds five (5) feet, the sides of the trench or excavation shall be supported by substantial sheeting, bracing, and shoring, or the sides sloped to the angle of repose. Sloping the sides of the ditch to the angle will not be permitted in streets, roads, narrow rights-of-way, or other constricted areas unless otherwise specified. The design and installation of all sheeting, sheet piling, bracing, and shoring shall be based on computations of pressure exerted by the materials to be retained under obtaining conditions. Adequate and proper shoring of all excavations shall be the entire responsibility of the Contractor; however, the Owner may require the submission of shoring plans (accompanied by supporting computations) for approval prior to the Contractor undertaking any portion of the work. The standards of the Federal Occupational Safety and Health Act and the Ohio Department of Labor shall be followed.
- B. Foundations, adjacent to where the excavation is to be made below the depth of the existing foundation, shall be supported by shoring, bracing, or underpinning as long as the excavation shall remain open, or thereafter if required to insure the stability of the structure supported by the foundation, and the Contractor shall be held strictly responsible for any damage to said foundations.
- C. Solid sheeting will be required for wet or unstable material. It shall consist of continuous vertical sheet piling of timber or steel with suitable wales and braces.
- D. Care shall be taken to avoid excessive backfill loads on the completed pipelines and the trench width requirements at the level of the crown of the pipe and at the level of a road or street be strictly observed.
- E. Trench sheeting shall not be removed until sufficient backfill has been placed to protect the pipe.
- F. All sheeting, planking, timbering, bracing and bridging shall be placed, renewed and maintained as long as is necessary.
- G. Contractor shall refer to the Geotechnical Soils Report (if available) prior to excavating.

3.1 PIPE BEDDING - GRAVITY SEWERS

- A. All gravity sewer pipe shall be laid on a bed of granular material except when a concrete encasement situation occurs. All pipe bedding material shall be No. 9 crushed stone aggregate and shall be placed to a depth of 4" in an earth trench and 6" in a rock trench. The Contractor will not be permitted to use dense graded aggregate material for pipe bedding.
- B. Pipe bedding shall be graded to provide for a uniform and continuous support beneath the pipe at all points.
- C. After each pipe has been brought to grade, aligned, and placed in final position, No. 9 crushed stone aggregate material shall be deposited and densified under the pipe haunches and on each side of the pipe up to the spring line of the pipe to prevent lateral displacement and hold the pipe in proper line of the pipe to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.
- D. In wet, yielding and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.
- E. Where an unstable (i.e. water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of crushed stone aggregate. The depth of the foundation is dependent upon the severity of the trench bottom. The size of stone aggregate used in the foundation will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required No. 9 crushed stone aggregate bedding material can be placed. No compensation for Crushed Stone for Pipe Foundation will be made if the instability of the trench bottom is caused by the Contractor's neglect.
- F. In no case shall pipe be laid directly on solid or blasted rock.

3.3 PIPE LAYING

- A. The pipe shall be protected during handling against impact shocks and free fall. Care shall be taken to avoid dragging the spigot ring on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.
- B. After being delivered alongside the trench, the pipe shall be carefully examined for soundness or damage. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. Before each piece of pipe is lowered into the trench, it shall be thoroughly cleaned out. Each piece of pipe shall be lowered separately. In the case of length of pipe being cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe.
- C. The bell and spigot of the joint shall be cleaned of dirt and foreign matter immediately prior to jointing. The contact surfaces shall be coated with the lubricant, primer or adhesive recommended by the pipe pushed together until the joint snaps distinctly in place. The pushing together of the pipe may be done by hand or by the use of a bar.
- D. All pipe shall be laid straight between changes in alignment and at uniform grade between changes in grade. When jointed in the trench the pipe shall form a true and smooth line.
- E. Trenches shall be kept dry during pipe laying. Before pipe laying is started, all water that may have collected in the trench shall be removed.
- F. All pipe shall be laid starting at the lowest point and installed so that the spigot ends point in the direction of the flow.

3.4 PIPE BACKFILLING

- A. Backfilling is defined as that material which is placed over the gravity sewer from the spring line to a predetermined point above the top of the pipe according to various backfilling situation as defined in Section C, this article. The material shall be No. 9 crushed stone aggregate and may be machine placed without compaction. Uneven places in the backfill shall be leveled by hand.
- B. There are two cases where the method of backfilling varies. The various cases and their trench situations are as follow:
 - 1. Case I - Areas not subject to vehicular traffic.
 - 2. Case II - Areas under bituminous pavement.
- C. In all cases, walking or working on the completed pipelines except as may be necessary in backfilling will not be permitted until the trench has been backfilled to a point six (6) inches above the top of the pipe. The method of final backfilling for each of the above cases is as follows:
 - 1. Case I - The trench shall be backfilled from a point 6" above the top of the pipe to a point 8" below the surface of the ground with earth material free from large rock (over one-half cubic foot in volume), acceptable to the Owner. The remainder of the trench to existing grade shall be backfilled with earth material reasonably free of any rocks.
 - 2. Case II - The trench shall be backfilled to the existing grade with No. 9 crushed stone until the bituminous pavement replacement can be constructed. Extreme care shall be exercised to prevent damage to the pipe during the backfilling operation. Suitable equipment shall "walk" the trench for compaction. A slight mound may be left if, in the opinion of the Owner, the public would not be inconvenienced. Sufficient stockpiles of No. 9 crushed stone shall be placed throughout the project area to insure immediate replacement by the Contractor of any settled areas. No extra payment will be made for the filling in of settled areas by the Contractor.
- D. Excavated materials from trenches and tunnels, in excess of quantity required for trench backfill, shall be disposed of by the Contractor. The Contractor may contact the Owner regarding the location of a suitable disposal site; however, if the Owner cannot recommend a site, it shall be the responsibility of the Contractor to obtain locations or permits for the disposal of the waste material.

3.5 CONNECTION TO EXISTING MANHOLES

- A. Where an existing manhole does not have existing stubs it will be necessary for the Contractor to construct a new invert for the existing manhole.

3.6 UTILITY CROSSING CONCRETE ENCASEMENT

- A. At locations shown on the Contract Drawings, required by the Specifications, or as directed by the Owner, concrete encasement shall be used when the clearance between the proposed sewer pipe and any existing utility pipe is eighteen (18) inches or less. Utility pipe includes underground water, gas, telephone and electrical conduit, and any other pipe as determined by the Owner.
- B. There are two cases of utility crossing encasement. Case I is applicable when the proposed sewer line is below the existing utility line. Case II is applicable when the proposed sewer line is laid above the utility line. In either case, the concrete shall extend to at least the spring line of each pipe involved.
- C. Concrete shall be Class B (3000 psi) and shall be mixed sufficiently wet to permit it to flow between the pipes to form a continuous bridge. In tamping the concrete, care shall be taken not to disturb the grade or line of either pipe or damage the joints.
- D. Concrete is not a separate pay item and will be considered incidental to gravity sewer installation.

3.7 BITUMINOUS PAVEMENT REPLACEMENT

- A. Sections of pavement shall be replaced as required to install the pipelines under the work of this Section. Disturbed pavement shall be reconstructed to original lines and grades with bituminous binder as detailed on the Drawings and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to these operations.
- B. Prior to trenching, the pavement shall be scored or cut to straight edges along each side of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be recut and trimmed as necessary to square, straight edges after the pipe has been installed and prior to placement of the binder course.
- C. Backfilling of trenches shall be in accordance with the applicable portions of Section 31000.
- D. Bituminous concrete binder shall be one course construction in accordance with applicable provisions of the State Department of Highways Standard Specifications.
 - 1. Placement and compaction of binder course shall be in accordance with the State Department of Highways Standard Specifications. Minimum thickness after compaction shall be as shown on the Drawings.

3.8 CRUSHED STONE BACKFILL

- A. The Class I granular material used in Case II and Case III backfill situations shall be No. 9 Crushed Stone aggregate (No. 9 Stone). Granular material will be paid for as a separate bid item.
- B. The twelve inches (12") of crushed stone backfill that is required in "City and County Maintained Streets, Roads, and Driveway Pavement Replacement" or "State Maintained Streets and Roads Pavement Replacement" will not be paid for under the provisions of this article.

3.9 CRUSHED STONE SURFACE REPLACEMENT

- A. The Class II granular material used in Case II backfill situations shall be dense graded aggregate (D.G.A.).

3.10 TESTING OF SEWERS

- A. After the gravity piping system has been brought to completion, and prior to final inspection, the contractor shall rod out the entire system by pushing through each individual line in the system, from manhole to manhole appropriate tools for the removal from the lines of any and all dirt, debris, and trash. If necessary during the process of rodding the system, water shall be turned into the system in such quantities to carry off the dirt, debris, and trash.
- B. During the final inspection, Owner's Representative may inspect each individual line, from manhole to manhole, either by use of lights, television, or other means at his disposal to determine whether the completed lines are true to line and grade as laid out or as shown on the Drawings.
 - 1. The Owner may require that the Contractor pass through the system under its own momentum a wooden ball of a diameter one inch less than the nominal diameter of the pipe, except that no ball larger than eight inches in diameter shall be used.

2. All lines or sections of lines that are found to be laid improperly with respect to line or grade, that are found to contain broken or leaking sections of pipe, or are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced at the Contractor's expense.
- C. The pipe line shall be made as nearly watertight as practicable, and leakage tests and measurements shall be made. All apparatus and equipment required for testing shall be furnished by the Contractor and the cost shall be included in the unit price bid for pipe and manholes.
 1. The Owner may require the Contractor to smoke test the first section (manhole to manhole) of each size of pipe and type of joint prior to backfilling, to establish and check laying and jointing procedures. The test shall consist of smoke blown into closed-off sections of sewer under pressure and observing any smoke coming from the pipe line indicating the presence of leaks. Other supplementary smoke tests prior to backfilling may be performed by the Contractor at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by the Owner.
 2. Where the ground water level is more than one foot above the top of the pipe at its upper end, the Contractor shall conduct either infiltration tests or low pressure air test on the completed pipeline.
 3. Where the ground water level is less than one foot above the top of the pipe at its upper end, the Contractor shall conduct either exfiltration tests or low pressure air tests on the completed pipeline.
- D. Low pressure air tests shall be made using equipment specifically designed and manufactured for the purpose of testing sewer lines using low pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal pressure in the pipeline cannot exceed 8 psig.
 1. The test shall be made on each manhole-to-manhole section of pipeline after placement of the backfill. The Engineer or his designated representative must be present to witness each satisfactory air test before it will be accepted as fulfilling the requirements of these specifications.
 2. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 3. Low pressure air passing through a single control panel, shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by ground water that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the ground water is greater than 4 psig, the Contractor shall conduct only an infiltration test.
 4. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by ground water that may be above the invert of the pipe) shall not be less than that shown in the following table:

<u>Pipe in Diameter in Inches</u>	<u>Minutes</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5
30	13.5

5. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.
- E. Infiltration tests shall be made after underdrains, if present, have been plugged and other ground water drainage has been stopped such that the ground water is permitted to return to its normal level insofar as practicable.
 1. Upon completion of a section of the pipeline, the line shall be dewatered and a satisfactory test conducted to measure infiltration for at least 24 hours. The amount of infiltration, including manholes, tees, and connections, shall not exceed 200 gallons per nominal inch diameter per mile of sewer per 24 hours.
- F. Exfiltration tests which subject the pipeline to an internal pressure, shall be made by plugging the pipe at the lower end and then filling the line and manholes with clean water to a height of 2 feet above the top of the sewer at its upper end. Where conditions between manholes may result in test pressures which would cause leakage at the plugs or stoppers in branches, provisions shall be made by suitable ties, braces, and wedges to secure the plugs against leakage resulting from the test pressure.
 1. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.
 2. Leakage from the sewers under test shall not exceed the requirements for leakage into sewers as herein before specified.
- G. The Contractor shall furnish suitable test plugs, water pumps, and appurtenances, and all labor required to properly conduct the tests. Suitable bulkheads shall be installed, as required, to permit the test of the sewer. The Contractor shall construct weirs or other means of measurements as may be necessary.
- H. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as the Engineer may require without additional compensation.
- I. If in the judgment of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer. In any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

3.11 TESTING OF FORCE MAINS

- A. The pipe shall be hydrostatically tested at 1.5 times the design working pressure at the point of testing. The duration of the test(s) shall be at least 2 hours during which time the pressure shall not fall more than 5 psi. The pipe shall be tested for allowable leakage according to AWWA C-600 (latest revision) concurrently with the pressure test.
- B. Where practicable, pipelines shall be tested between line valves or plugs in lengths of not more than 3000 feet. testing shall proceed from the pump station toward the termination of the line. The line shall be tested upon the completion of the first 3000 feet. After the completion of two consecutive tests without failure, the Contractor, at his option and with the Engineer's approval, may discontinue testing until the system is complete.
- C. Duration of test shall be not less than 2 hours.
- D. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.
- E. All pipe, fittings, and other materials found to be defective under test shall be removed and replaced at the Contractor's expense.
- F. Test pressures shall not be less than 1.25 times the working pressure at the highest point along the test section, not exceed pipe or thrust restraint design pressure, not vary more than +5 psi.
- G. Before applying the specified test pressure, air shall be expelled completely from the pipe. If permanent air vents are not located at high points within the test section, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water.

3.12 LEAKAGE TEST

- A. The leakage shall be defined as the quantity of water that must be supplied to the tested section to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
- B. The allowable leakage shall not be greater than that determined by the following formula:

$$L = \frac{ND(P)}{7400}^{1/2}$$

Where L is the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

- C. All visible leaks are to be repaired regardless of the amount of leakage.
- D. or Concrete and Corrugated Pipe Sewers:
 - 1. Prior to backfilling and laying additional pipe, test the first 100 feet of sewer construction for leakage.
 - 2. Fill the sewer with water and maintain a head two feet above the highest section of Work being tested. Measure the quantity of leakage. When the sewer being tested is constructed in water bearing soil, the leakage test may, at the discretion of the Owner's Representative, be made by measuring the quantity of infiltration into the sewer. The allowable leakage or infiltration shall not be exceeded.
 - 3. The rate of leakage or infiltration shall not exceed 50 gallons per 24 hours per inch pipe diameter per 1000 feet of sewer being tested.

3.13 PLACEMENT OF IDENTIFICATION TAPE

- A. The placement of detectable underground marking tape shall be installed over all utility lines. Care shall be taken to insure that the buried marking tape is not broken when installed and shall be Lineguard brand encased aluminum foil, Type III. The identification tape is manufactured by Lineguard, Inc., P. O. Box 426, Wheaton, Illinois 60187.
- B. The identification tape shall bear the printed identification of the utility line below it, such as "CAUTION - BURIED FORCE MAIN BELOW". Tape shall be reverse printed, surface printing will not be acceptable. The tape shall be visible in all types and colors of soil and provide maximum color contrast to the soil. The tape shall meet the APWA color code, and shall be two (2) inches in width. Colors are: yellow - gas; green - sewer; red - electric; blue - water; orange - telephone; brown - force main.
- C. The tape shall be the last equipment installed in the ditch so as to be first out. The tape shall be buried 4 - 6 inches below top of grade. After trench backfilling, the tape shall be placed in the backfill and allowed to settle into place with the backfill. The tape may be plowed in after final settlement, installed with a tool during the trench backfilling process, unrolled before final restoration, or installed in any other way acceptable to the owner or his agent or engineer.

SECTION 33391 – MANHOLES, FRAMES & COVERS FOR SEWERS**PART 1 GENERAL****1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 RELATED WORK

- A. Section 310000 - Earthwork
- B. Section 33310 – Drainage Pipe and Fittings for Sewers

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- A. Obtain necessary permits from local Authorities. Ascertain and comply with local requirements for materials, construction and restoration of pavement.

1.3 SUBMITTALS

- A. Shop Drawings (if requested by Owner): Show fabrication details and connections to adjacent Work.
- B. Product Data (if requested by Owner): Manufacturer's catalog cuts, specifications, and installation instructions.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Precast Reinforced Concrete Manholes:
 - 1. Riser Sections: ASTM C 478.
 - 2. Joints Between Riser Sections-One of the following:
 - a. Rubber Gaskets: ASTM C 443.
 - b. Butyl Joint Sealant: ConSeal CS-202 by Concrete Sealants, Inc., 8917 S. Palmer Rd., P. O. Box 176, New Carlisle, OH 45344, (513) 845-8776.
 - 3. Concrete for Precast Units: Air content 6 percent by volume with an allowable tolerance of plus or minus 1.5 percent. Minimum compressive strength of 4,000 psi after 28 days.
 - 4. Load Rating: AASHTO HS-20 with 30% impact and 130 lb/cf equivalent soil pressure.
- B. Glass-Fiber Reinforced Polyester Manholes:
 - 1. One-Piece Monolithic Unit: ASTM D 3753.
 - 2. Nominal Inside Diameter: 48 inches.
 - 3. Minimum Wall Thickness: 0.480 inch.
 - 4. Concentric Cone Top:
 - a. Minimum Clear Opening: 30 inches.
 - 5. Load Rating: AASHTO HS-20 with 30% impact and 130 lb/cf equivalent soil pressure.
 - 6. Acceptable Fiberglass Manhole Manufacturers: Containment Solutions, Inc., 5150 Jefferson Chemical Rd., Conroe, TX 77301, (888) 409-7731; L.F. Manufacturing, P.O. Box 578, Highway 290 East Giddings, Texas 78942, (800) 237-5791.
- C. Precast Reinforced Square and Rectangular Concrete Structures:
 - 1. Riser Sections: ASTM C890.
 - 2. Keyed Joints:
 - a. Joint Sealant - Select One:

- 1) Mortar
 - 2) Rubber Gasket
 - 3) Butyl Joint Sealant
3. Load Rating: AASHTO HS-20 with 30% impact and 130 lb/cf equivalent soil pressure.
4. Concrete for Precast Units: Air content 6 percent by volume with an allowable tolerance of plus or minus 1.5 percent. Minimum compressive strength of 4,000 psi after 28 days.
- D. Cast-in-Place Concrete for Manhole Invert Channels: Normal weight, air entrained concrete with a minimum compressive strength of 4,000 psi after 28 days.
 1. Design Air Content: 6 percent by volume plus or minus 1.5 percent.
 2. Cement: Minimum 610 pounds per cubic yard.
 3. Slump: Between 2 and 3 inches.
- E. Drop Piping:
 1. Outside Drop:
 - a. Ductile Iron Pipe: ANSI/ASTM A-746, Class 50.
 - b. Polyvinyl Chloride Pipe: PVC compound ASTM D1784, Pipe ASTM D-3034, SDR-26.
 2. Inside Drop:
 - a. Polyvinyl Chloride Pipe: PVC compound ASTM D1784, Pipe ASTM D-3034, SDR-26.
- F. Frames, Covers and Grates for Manholes and Catch Basins:
 1. Design of each shall be the same throughout the project unless otherwise specified or indicated on the drawings.
 2. Units shall meet AASHTO H20 wheel loading requirements. Manufacture, workmanship and certified proof-load tests shall conform to AASHTO M306-89-Standard Specification for Drainage Structure Castings.
 3. Material:
 - a. Cast iron: ASTM A48, Class 30B or 35B.
 - b. Delivered to Site free of any coatings, unless otherwise specified.
 4. Frames:
 - a. Round with a 30-inch clear opening.
 5. Covers:
 - a. Round.
 - b. Solid lid, top surface checkered and provided with suitable concealed lifting notches, and lettering cast into cover to indicate type of structure.
 6. Grates:
 - a. Round.
 - b. Minimum open area: 232 sq inches.
 - c. Bicycle safe.
 7. Provide frames, covers, and gratings of the locking type when indicated on the drawings.
 - a. Acceptable Locking Devices: Type J or Type H by Neenah Foundry Company, P. O. Box 729, Neenah, WI 54957, (414) 729-3661; Type A or Type B by Syracuse Casting Sales Corporation, P. O. Box 190, South Bay Rd., Cicero, NY 13039, (315) 699-2601.
 8. Acceptable Manhole Frames and Covers: Pattern R-1557-A with platen cover by Neenah Foundry Company, P. O. Box 729, Neenah, WI 54957, (414) 729-3661; Pattern 1012A with platen cover by Syracuse Castings Sales Corp., P. O. Box 190, South Bay Rd., Cicero, NY 13039, (315) 699-2601.
 9. Acceptable Catch Basin Frames and Gratings: Pattern R-2557-A frame with Pattern R-2580-A, Type G grate by Neenah Foundry Company, P. O. Box 729, Neenah, WI 54957, (414) 729-3661; Pattern 1012451XC frame with Pattern 1187025 grate by Syracuse Casting Sales Corp., P. O. Box 190, South Bay Rd., Cicero, NY 13039, (315) 699-2601.

- G. Curb Inlet Frames, Grates and Curb Boxes:
 - 1. Designed to meet AASHTO H20 wheel loading requirements. Manufacture, workmanship and certified proof-load tests shall conform to AASHTO M306-89-Standard Specification for Drainage Structure Castings.
 - 2. Material:
 - a. Cast iron: ASTM A 48, Class 30B or 35B.
 - b. Delivered to the Site free of any coatings, unless otherwise specified.
 - 3. Frames: Square top with round 36-inch OD base flange and integral stiffeners.
 - 4. Grates:
 - a. Rectangular.
 - b. Bicycle safe.
 - 5. Acceptable Curb Inlets: Pattern R-3010 with Type A grate by Neenah Foundry Company, P. O. Box 729, Neenah, WI 54957, (414) 729-3661; Pattern 2640 by Syracuse Castings Sales Corp., P. O. Box 190, South Bay Rd., Cicero, NY 13039, (315) 699-2601.
- H. Drop Inlet Frames and Grates:
 - 1. Designed to meet AASHTO H20 wheel loading requirements. Manufacture, workmanship and certified proof-load tests shall conform to AASHTO M306-89-Standard Specification for Drainage Structure Castings.
 - 2. Material:
 - a. Cast iron: ASTM A 48, Class 30B or 35B.
 - b. Delivered to Site free of any coatings, unless otherwise specified.
 - 3. Frames: Slab type, 24-inch square clear opening.
 - 4. Grates:
 - a. Bicycle safe.
 - 5. Acceptable Drop Inlet Frames and Grates: Pattern R-3562 by Neenah Foundry Company, P. O. Box 729, Neenah, WI 54957, (414) 729-3661; Pattern 1396440 frame with Pattern 1396040 grate by Syracuse Castings Sales Corp., P. O. Box 190, South Bay Rd., Cicero, NY 13039, (315) 699-2601.
- I. Pipe-to-Manhole/Drainage Structure Connections-One of the following:
 - 1. A-Lok Flexible Connector by A-Lok Products, Inc., 697 Main St., Tullytown, PA 19007, (215) 547-3366.
 - 2. Lockjoint Flexible Connector by Chardon Rubber Company, 373 Washington St., Chardon, OH 44024, (216) 285-2161.
 - 3. Kor-N-Seal Flexible Connector by NPC, Inc., 250 Elm St., Milford, NH 03055, (601) 673-8680.
 - 4. Link-Seal Flexible Connector by Thunderline Link-Seal, Inc., 6525 Goforth St., Houston, TX 77021, (713) 747-8819.
- J. Mortar: ASTM C 270, Type M.

PART 3 EXECUTION

3.0 PREPARATION

- A. Sewer Lateral Openings in Precast and Cast-in-Place Concrete Risers: Provide openings and install pipe connectors in strict accordance with the recommendation of the connector manufacturer.

3.1 INSTALLATION

- A. Construct concrete structures with precast reinforced riser sections to the dimensions shown. Seal joints between precast riser sections with material specified.
 - 1. Wall thickness for circular structures 12 feet deep or less: 5 inches.
 - 2. Wall thickness for circular structures greater than 12 feet deep: 6 inches.
- B. Position tops of structures flush with finished grade.

- C. Form inverts in manholes on straight runs by the use of channel pipe. Form inverts in manholes at changes in direction or grade by making curved channels of concrete. Channels shall have a smooth surface free from irregularities.
- D. Cut laterals which will enter above the invert to correct length before installation. Do not cut after installation. Construct drops as shown.
- E. Install glass-fiber reinforced polyester manholes as detailed on the Drawing and in accordance with the manufacturer's printed installation procedures.
- F. Construct drop inlets of concrete or precast units.
- G. Install curb inlets where indicated.

SECTION 33462 - GEOTEXTILE SUBSURFACE DRAINAGE FILTRATION

PART 1 GENERAL

1.0 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Requirements and Division 00 Specification Sections, apply to this Section.

1.1 RELATED WORK

- A. Section 31000 - Earthwork
- B. Section 33310 – Drainage Pipe and Fittings for Sewers

1.2 SUBMITTALS

- A. Product Data (if requested by Owner): Manufacturer's catalog sheets, specifications, and installation instructions for each item specified.
- B. Samples (if requested by Owner): 12 inch x 12 inch sample of prefabricated drainage panel.

PART 2 PRODUCTS

2.0 MATERIALS

- A. Prefabricated Drainage Panel; Any of the following best fitting the specific application:
 - 1. MIRADRAIN 6000 by Nicolon/Mirafi Group, 3500 Parkway Ln., Suite 500, Norcross, GA 30092, (800) 234-0484.
 - 2. J-Drain 300 Composite Drainage System by JDR Enterprises, Inc., 725 Branch Dr., Alpharetta, GA 30201, (800) 843-7569.
 - 3. Hydraway 300 by Monsanto, 2381 Centerline Industrial Dr., St. Louis, MO 63146, (800) 325-4330.

PART 3 EXECUTION

3.1 PROTECTION

- A. Protect prefabricated drainage panel from sunlight during transportation and storage.

3.2 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's printed instructions.