

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. 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, center-guided check valves.
- 11. Iron, plate-type check valves.
- 12. Bronze gate valves.
- 13. Iron gate valves.
- 14. Bronze globe valves.
- 15. Iron globe valves.
- 16. Lubricated plug valves.

- B. Related Sections:

- 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 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.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 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.

1.6 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

2.1 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 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. 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.

2.2 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.
 - c. Crane
 - d. Stockham
 - 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 .

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

- 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 Valve, Inc.
 - b. Crane
 - c. Stockham
- 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.

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.
 - c. Stockham
- 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.

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. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. Powell Valves.
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 .

2.3 BRASS BALL VALVES

A. One-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
 - b. Stockham
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 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. Hammond Valve.
- d. Jamesbury; a subsidiary of Metso Automation.
- e. Kitz Corporation.
- f. 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. Hammond Valve.
- b. Crane
- c. Legend Valve.
- d. Stockham
- e. 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. Crane
- b. Stockham

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 Stainless-Steel Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Crane
 - b. Bradley
 - c. Apollo
 - 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: 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.

2.4 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. Stockham
- 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. Bradley
 - c. Milwaukee Valve Co.
- 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. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. Red-White Valve Corporation.
 - i. 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. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. DynaQuip Controls.
 - f. Hammond Valve.
 - g. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - h. 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: Bronze.
 - i. Ball: Chrome-plated brass.
 - 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. Conbraco Industries, Inc.; Apollo Valves.
 - b. DynaQuip Controls.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. Red-White Valve Corporation.
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.

2.5 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.
 - d. American Valve Co.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - 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. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. Mueller Steam Specialty; a division of SPX Corporation.
 - e. Red-White Valve Corporation.
 - f. 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.

2.6 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. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. 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.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. Red-White Valve Corporation.
 - g. 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. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.

- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Milwaukee Valve Company.
- f. Red-White Valve Corporation.

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.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. 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.

2.7 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. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. Powell Valves.
- i. Red-White Valve Corporation.

- j. 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. Handwheel: Malleable iron, bronze.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. Powell Valves.
- i. 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. Handwheel: Malleable iron , bronze .

C. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

- a. Hammond Valve.
- b. Kitz Corporation.
- c. Milwaukee Valve Company.
- d. Powell Valves.
- e. Red-White Valve Corporation.
- f. 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 .

D. Class 150, RS Bronze 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. Hammond Valve.
- d. Kitz Corporation.
- e. Milwaukee Valve Company.
- f. Powell Valves.
- g. 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.

2.8 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.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.

- i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Co.
- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. Powell Valves.
 - f. 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.

2.9 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.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. Powell Valves.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).

- 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 .

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.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Co.
 - d. Red-White Valve Corporation.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - 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.

2.10 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.
 - b. Homestead Valve Co.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular 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.
 - b. Homestead Valve Co.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: [Regular 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.
 - d. Homestead Valve Co.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - 1) CWP Rating: 200 psig.
 - b. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - c. Pattern: Regular Venturi.
 - d. 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/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short 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.
 - b. Homestead Valve Co.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short 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.
 - b. Homestead Valve Co.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short 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/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short 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/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 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.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.

2. Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball, butterfly, or gate valves.
 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 3. Throttling Service: Globe valves.
 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze 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, 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.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Three piece, full regular port, bronze with stainless-steel trim.
 3. Bronze Lift Check Valves: Class 125, bronze disc.
 4. Bronze Swing Check Valves: Class 125 bronze disc.
 5. Bronze Gate Valves: Class 125, NRS.

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, Single-Flange Butterfly Valves: 200 CWP, NBR seat, stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves: 175 300 CWP.
4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 125 compact-wafer resilient seat.
7. Iron, Plate-Type Check Valves: Class 125; single plate; resilient seat.
8. Iron Gate Valves: Class 125, NRS.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG:

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves Three piece, full port, bronze with stainless-steel trim.
3. Bronze Lift Check Valves: Class 125, bronze disc.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.

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, Single-Flange Butterfly Valves: 200 CWP, NBR seat, stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves: 175 CWP.
4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.
7. Iron, Plate-Type Check Valves: Class 125; single plate; resilient seat.
8. Iron Gate Valves: Class 125, NRS.

3.7 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 bronze disc.
3. Ball Valves: Three piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.
6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
4. Iron, Grooved-End Butterfly Valves: 175 CWP.
5. Iron Swing Check Valves: Class 125 nonmetallic-to-metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
7. Iron, Grooved-End Swing Check Valves: 300 CWP.
8. Iron, Center-Guided Check Valves: Class 125, compact-wafer resilient seat.
9. Iron, Plate-Type Check Valves: Class 125; single plate resilient seat.
10. Iron Gate Valves: Class 125, NRS.
11. Iron Globe Valves: Class 125.

3.8 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 stainless-steel disc.
3. Ball Valves: Three piece, full port, with stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.
6. Bronze Globe Valves: Class 125, bronze 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 125, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron Gate Valves: Class 125, NRS.
7. Iron Globe Valves: Class 125.
8. Lubricated Plug Valves: Class 125, regular gland.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

- B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.
- D. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

- 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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - h. B-Line Inc.
- 3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
- 4. Standard: MFMA-4.
- 5. Channels: Continuous slotted steel channel with intumed lips.
- 6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- 8. Metallic Coating: Hot-dipped galvanized.
- 9. Paint Coating: Epoxy.
- 10. Plastic Coating: PVC.

2.4 THERMAL-HANGER SHIELD INSERTS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.

6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig.
 - D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig.
 - 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.

2.5 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.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Plastic.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel rod with plastic or roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 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 supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

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

2.8 EQUIPMENT SUPPORTS

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

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal 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 the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. 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.
- F. Pipe Stand Installation:
 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 "Plumbing Fixtures" Sections for requirements for pipe positioning systems for plumbing fixtures.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. 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.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. 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 or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

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

3.4 ADJUSTING

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

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: 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. Section "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports] [metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, 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 noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, 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 or carbon-steel plate.
 - 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 or carbon-steel plate, 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 two 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 24, 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.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. 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.
- K. 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.
- L. 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.
- M. 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 allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [1/16 inch to 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamelblack unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: [Aluminum, 0.032-inch (anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum Approximately 4 by 7 inches.
 - 2. Fasteners: Reinforced grommet and wire or string.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting-High-Performance Coatings."

- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Low-Pressure, Compressed-Air Piping:
 - a. Background Color: Black.
 - b. Letter Color: White.
 - 2. Medium-Pressure, Compressed-Air Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.
 - 3. Domestic Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.
 - 4. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Cold Water: 1-1/2 inches 2 inches], square.
- b. Hot Water: 1-1/2 inches 2 inches, square.
- c. Low-Pressure Compressed Air: 1-1/2 inches 2 inches (50 mm), square.
- d. High-Pressure Compressed Air: 1-1/2 inches (38 mm)2 inches, square.

2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Natural.
- c. Low-Pressure Compressed Air: Natural.
- d. High-Pressure Compressed Air: Natural.

3. Letter Color:

- a. Cold Water: Black.
- b. Hot Water: Black.
- c. Low-Pressure Compressed Air: Black.
- d. High-Pressure Compressed Air: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied fabric-reinforcing mesh.
- 9. Field-applied cloths.
- 10. Field-applied jackets.
- 11. Tapes.
- 12. Securements.
- 13. Corner angles.

- B. Related Sections include the following:

- 1. Division 21 Section "Fire-Suppression Systems Insulation."
- 2. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 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: For each type of insulation and jacket indicated. (Required only upon request by UM.) 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 (DN 50).
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2 (DN 50).
 - 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: For qualified Installer.
- E. Material Test Reports: 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.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. 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.

1.5 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.

1.6 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.

1.7 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

2.1 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. 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 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.
- F. 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, provide one of the following 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. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- G. 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, provide one of the following 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.
- H. 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 without factory-applied jacket with factory-applied ASJ with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- I. 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, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Fibrex Insulations Inc.; FBX.
- b. Johns Manville; 1000 Series Spin-Glas.
- c. Owens Corning; High Temperature Industrial Board Insulations.
- d. Rock Wool Manufacturing Company; Delta Board.
- e. Roxul Inc.; Roxul RW.
- f. Thermafiber; Thermafiber Industrial Felt.

J. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000(Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. 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.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ jacket] 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, provide one of the following 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. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
 - f.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following 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, provide one of the following 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/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following 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.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 - 2. 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following 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.

- e. Mon-Eco Industries, Inc.; 22-25.
 - D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following 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.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. 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).
 - E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 - 2. 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).
- 2.4 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 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.

- d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-30.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
 - c. ITW TACC, Division of Illinois Tool Works; CB-25.
 - d. Marathon Industries, Inc.; 501.
 - e. Mon-Eco Industries, Inc.; 55-10.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Encacel.
 - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
 - c. Marathon Industries, Inc.; 570.
 - d. Mon-Eco Industries, Inc.; 55-70.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.

- c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.5 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 50 g/L 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 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.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following 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.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 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 biaxially 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, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially 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, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Dow Chemical Company (The); 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, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vimasco Corporation; Elastafab 894.
- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
 1. Products: Subject to compliance with requirements, the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Chil-Glas No. 5.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.
 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: [thick, heat-bonded polyethylene and kraft paper3-mil- thick, heat-bonded polyethylene and kraft paper] Moisture

Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

d. Factory-Fabricated Fitting Covers:

- 1) Same material, finish, and thickness as jacket.
- 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 3) Tee covers.
- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

- a. Factory cut and rolled to size.
- b. Material, finish, and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper] 3-mil- thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
- e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.11 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, provide one of the following 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, provide one of the following 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, provide one of the following 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, provide one of the following 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.
 - 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, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following 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/A 240M, Type 304 or Type 316; 0.015 inch thick, [1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), 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, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following 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, provide one of the following 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: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following 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. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- c. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following 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. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following 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. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Stainless 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, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following 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, provide one of the following 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, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.13 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 (ASTM B 209M), 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

3.1 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.

3.2 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. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. 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 demineralized water.

3.3 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 [2 inches] [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. Handholes.
6. Cleanouts.

3.4 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 Firestopping" 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 Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least [0.040 inch] [0.050 inch] [0.060 inch] thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 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.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

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

D. Insulation Installation on Valves and Pipe Specialties:

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

3.8 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.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of

inspection shall be limited to [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, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

- A. Round, exposed breeching and connector insulation shall be the following:
 1. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 2. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.
- B. Round, concealed breeching and connector insulation shall be the following:
 1. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 2. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.
- C. Rectangular, exposed breeching and connector insulation shall be the following:
 1. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 2. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.
- D. Rectangular, concealed breeching and connector insulation shall be the following:
 1. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 2. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.

3.13 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. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be one of the following:
 1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.
 2. Mineral-Fiber Pipe and Tank: 2 inches thick.
- D. Steam-to-hot-water converter insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.
 2. Mineral-Fiber Pipe and Tank: 2 inches thick.
- E. Domestic water pump insulation shall be the following:
1. Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.
- F. Domestic chilled-water (potable) pump insulation shall be the following:
1. Mineral-Fiber Board: 2 inches and 6-lb/cu. ft. nominal density.
- G. Domestic hot-water pump insulation shall be [one of] the following:
1. Mineral-Fiber Board: 1 inch (25 mm thick and 6-lb/cu. ft. nominal density).
- H. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber Board: 1 inch thick and [6-lb/cu. ft. nominal density.
 3. Mineral-Fiber Pipe and Tank: 1 inch thick.
- I. Domestic hot-water storage tank insulation shall be [one of] the following, of thickness to provide an R-value of 12.
1. Mineral-Fiber Board: 6-lb/cu. ft. (96-kg/cu. m) nominal density.
 2. Mineral-fiber pipe and tank.
- J. Domestic water storage tank insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber Board: 1 inch thick and [6-lb/cu. ft. nominal density.
 3. Mineral-Fiber Pipe and Tank: 1 inch thick.

3.14 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.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
1. NPS 1" and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 2. NPS 1-1/4" and Larger: Insulation shall be one of the following:

- a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4" and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch (19 mm).
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/2" and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - C. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - D. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - F. 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 inch thick.
 - G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving 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 inch thick.
- 3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.17 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
 1. Aluminum, Smooth 0.024 inch (0.61 mm.)

3.18 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Exposed:
 1. Stainless Steel, Type 304 or 316, Smooth 2B Finish: 0.020 inch thick.
 2. Aluminum, Smooth: 0.016 inch thick.

3.19 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.

1.3 SUBMITTALS

- A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Backflow preventers and vacuum breakers.
6. Water penetration systems.

- B. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. Compressed air piping.
4. HVAC hydronic piping.
5. RPS Piping.
6. Distilled water piping.

- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
 - 1. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint.
 - 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) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 3. Copper Push-on-Joint Fittings:
 - 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) 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.
- 4. Copper-Tube Extruded-Tee Connections:
 - 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) T-DRILL Industries Inc.
 - 2) NIBCO
 - b. Description: Tee formed in copper tube according to ASTM F 2104.
 - c. 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) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - d. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - e. 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 (ASTM B 88M, Type B) water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 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) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.

2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet.
- C. Material: LLDPE film of 0.008-inch (0.20-mm) LLDPE film of 0.008-inch (0.20-mm) minimum thickness or high-density, cross-laminated PE film of 0.004-inch (0.10-mm) High-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- D. Color: Black or Natural.

2.5 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.

2.6 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. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.

2.7 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. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
2. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. 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 noncorrosive, thermoplastic.

D. 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: 150 psig at 180 deg F (107 deg C).
 - c. End Connections: Male threaded.
 - d. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Flex Pression, Ltd.
 - 4. Flex-Weld, Inc.
 - 5. Hyspan Precision Products, Inc.
 - 6. Mercer Rubber Co.
 - 7. Metraflex, Inc.
 - 8. Proco Products, Inc.
 - 9. Tozen Corporation.
 - 10. Unaflex, Inc.
 - 11. Universal Metal Hose; a Hyspan company
- B. 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 (1380 kPa) 250 psig (1725 kPa).
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 EARTHWORK

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

3.2 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 underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- D. 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.
- E. Install shutoff valve immediately upstream of each dielectric fitting.

- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- G. Install domestic water piping level and plumb.
- H. 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.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. 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.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads 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," "Braze 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. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. 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.

3.4 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.

- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 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:

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 2" and Smaller use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 2 1/2" to 4": Use dielectric nipples.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

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 : 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.

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.

3.10 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.

3.11 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 Construction Manager at least one day before inspection must be made. Perform tests specified below in presence of Construction Manager:
 - 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 Construction Manager to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: Construction Manager 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 Construction Manager.
- 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.

3.12 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.

3.13 CLEANING

A. Clean and disinfect potable and 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 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:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow standing for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow standing for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. 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.

3.14 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- C. Under-building-slab, domestic water, building service piping, NPS 3/4" and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger 4" to 8", shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 2" to 4" size range , shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B wrought- copper solder-joint fittings; and soldered joints.
- G. Aboveground domestic water piping, NPS 5 to NPS 8 5" to 8", shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. 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. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Outlet boxes.
 - 8. Hose stations.
 - 9. Hose bibbs.
 - 10. Wall hydrants.
 - 11. Drain valves.
 - 12. Water hammer arresters.
 - 13. Air vents.
- B. Related Sections include the following:
 - 1. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 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. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.

- j. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
- 1. 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. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1020.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 - 5. Size: See contract documents.
 - 6. Design Flow Rate: See contract documents.
 - 7. Selected Unit Flow Range Limits: See contract documents.
 - 8. Pressure Loss at Design Flow Rate: See contract documents.
 - 9. Accessories:
 - a. Valves: Ball type, on inlet and outlet.
- D. Laboratory-Faucet Vacuum Breakers:
- 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. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1035.
 - 3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
 - 4. Body: Bronze.
 - 5. End Connections: Threaded.
 - 6. Finish: Chrome plated.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

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. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2.
5. Body: Bronze.
6. End Connections: Union joint.
7. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

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. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: See contract documents.
6. Design Flow Rate: See contract documents.
7. Selected Unit Flow Range Limits: See contract documents.
8. Pressure Loss at Design Flow Rate: See contract documents.
9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories:

- a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention 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. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1015.
- 3. Operation: Continuous-pressure applications, unless otherwise indicated.
- 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- 5. Size: See contract documents.
- 6. Design Flow Rate: See contract documents.
- 7. Selected Unit Flow Range Limits: See contract documents.
- 8. Pressure Loss at Design Flow Rate: See contract documents.
- 9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved.
- 10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 11. Configuration: Designed for horizontal, straight through flow.
- 12. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Double-Check, Detector-Assembly Backflow Preventers:

- 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. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1048 and FMG approved or UL listed.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- 5. Size: See contract documents.

6. Design Flow Rate: See contract documents. Selected Unit Flow Range Limits: See contract documents. Pressure Loss at Design Flow Rate: See contract documents.
7. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
8. End Connections: Flanged.
9. Configuration: Designed for horizontal, straight through flow.
10. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

E. Hose-Connection Backflow Preventers:

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. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

F. Backflow-Preventer Test Kits:

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. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

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. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: See Drawings.
5. Design Flow Rate: See Drawings.
6. Design Inlet Pressure: See Drawings.
7. Design Outlet Pressure Setting: See Drawings.
8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing 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. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
2. Type: Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Primary, Thermostatic, Water Mixing 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. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa).
4. Type: Cabinet-type, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Tempered-Water Setting:
10. Tempered-Water Design Flow Rate:
11. Selected Valve Flow Rate at 45-psig Pressure Drop:
12. Pressure Drop at Design Flow Rate: 5 psig.
13. Valve Finish: Polished, chrome plated.
14. Piping Finish: Copper.
15. Cabinet: Factory-fabricated, stainless steel, for recessed mounting and with hinged, stainless-steel door.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch 0.033 inch 0.062 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
6. Drain: Pipe plug.

2.6 OUTLET BOXES

A. Icemaker Outlet Boxes:

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.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.

4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include wall flange with each chrome- or nickel-plated hose bibb.

2.8 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

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. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Domestic Water Piping" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.

- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs.
- I. Install water hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
 - 8. Double-check, detector-assembly backflow preventers.
 - 9. Water pressure-reducing valves.
 - 10. Primary, thermostatic, water mixing valves.
 - 11. Manifold, thermostatic, water-mixing-valve assemblies.

12. Outlet boxes.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

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. Waste, Force-Main Piping: 50 psig.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy classes.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MG Piping Products Company.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
- E. Copper Pressure Fittings:
 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. 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.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.

- 4) JCM Industries, Inc.
- 5) Romac Industries, Inc.
- 6) Smith-Blair, Inc.; a Sensus company.
- 7) The Ford Meter Box Company, Inc.
- 8) Viking Johnson.

- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.
 - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elster Perfection.
 - 2) Grinnell Mechanical Products.
 - 3) Matco-Norca, Inc.
 - 4) Precision Plumbing Products, Inc.
 - 5) Victaulic Company.
 - b. Description:

- 1) Electroplated steel nipple complying with ASTM F 1545.
- 2) Pressure Rating: 300 psig at 225 deg.
- 3) End Connections: Male threaded or grooved.
- 4) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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 two 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.
- K. 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.

- L. 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 1/8" per foot. 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.
- M. 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."
- N. Install steel piping according to applicable plumbing code.
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- 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. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- Q. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
- R. Install force mains at elevations indicated.
- S. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 Section "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.2 JOINT CONSTRUCTION

- A. 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.

- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- 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 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.
- D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.3 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded, nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.4 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Comply with requirements for backwater valve specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install 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.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and 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.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. 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 and 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.
- H. Install supports for vertical copper tubing every 10 feet (3 m).
- I. 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor.
 - 6. Comply with requirements for backwater valves cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
 - 7. 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.
 - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. 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.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary 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.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be the following:
 - 1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
- I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be the following:
 - 1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Roof flashing assemblies.
 - 4. Through-penetration firestop assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Floor Drain.
 - 2. Cleanout.
 - 3. Specialties.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. 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

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. 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. Josam Company; Josam Div.
 - 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; Specification Drainage Operation.
 - f. Josam Company; Blucher-Josam Div.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch Hubless, cast-iron soil pipe test tee Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Countersunk plastic 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. 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. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 - i. Josam Company; Josam Div.
 - j. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - k. Josam Company; Blucher-Josam Div.
2. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Spigot.
8. Closure: Brass plug with straight threads and gasket Brass plug with tapered threads Cast-iron plug Plastic plug.

9. Adjustable Housing Material: Cast iron set-screws or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
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 or raised-head drilled-and-threaded brass 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.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. 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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3 with backwater valve.
3. Pattern: Area Floor Funnel floor Sanitary drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.

7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Top or Strainer Material: Bronze or Nickel bronze.
12. Top of Body and Strainer Finish: Nickel bronze or Stainless Steel.
13. Top Shape: Square.
14. Top Loading Classification: Heavy Duty.
15. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
16. Trap Material: Cast iron.
17. Trap Pattern: Deep-seal P-trap.
18. Trap Features: Cleanout and trap-seal primer valve drain connection.

B. Automatic Trap Primer for Floor Drain

1. Provide in locations where water seal might be evaporated.
2. Automatic Trap Primer shall be connected domestic cold water line. DO NOT CONNECT install on cold water line serving a drinking fountain only.
3. Install in a horizontal position.
4. 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. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Sioux Chief Manufacturing
 - d. Watts
 - e. Zurn

2.3 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:
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. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 6 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.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop 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 firestopping plug.
4. Size: Same as connected soil, waste, or vent stack.
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/A 48M, 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.

2.5 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 (DN 15) 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 fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

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.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. thickness.
2. Vent Pipe Flashing: 8 oz./sq. ft. thickness.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

- 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- I. Assemble open drain fittings and install with top of hub 1 inch (25 mm) above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on 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.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install wood-blocking reinforcement for wall-mounting-type specialties.
- P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.

- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.
 - 4. Through-penetration firestop assemblies.
 - 5. Flashing materials.

1.3 SUBMITTALS

- A. Product Data: 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.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom Side.
7. Extension Collars: Required.
8. Underdeck Clamp: As Required.
9. Expansion Joint: Not required.
10. Sump Receiver Plate: Required.
11. Dome Material: Cast iron.
12. Perforated Gravel Guard: Stainless steel.
13. Vandal-Proof Dome: Required.
14. Water Dam: 2 inches high.

B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Portals Plus; Commercial Products Group of Hart & Cooley, Inc.
 - e. Smith, Jay R. Mfg. Co.
 - f. Tyler Pipe.
 - g. Watts Water Technologies, Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: 8- to 12-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom Side.
7. Extension Collars: Required.
8. Underdeck Clamp: Required.
9. Expansion Joint: Not required.
10. Sump Receiver Plate: Required.
11. Dome Material: Cast iron.
12. Wire Mesh: Not required.
13. Vandal-Proof Dome: Required.
14. Water Dam: 2 inches high.

C. Cast-Iron, Small-Sump, General-Purpose Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.

- d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.4, for general-purpose roof drains.
 - 3. Body Material: Cast iron.
 - 4. Dimension of Body: Nominal 8-inch diameter.
 - 5. Combination Flashing Ring and Gravel Stop: Required.
 - 6. Outlet: Bottom Side.
 - 7. Extension Collars: Required.
 - 8. Underdeck Clamp: Required.
 - 9. Expansion Joint: Not required.
 - 10. Sump Receiver Plate: Required.
 - 11. Dome Material: Cast iron.
 - 12. Wire Mesh: Not required.
 - 13. Vandal-Proof Dome: Required.

D. Metal, Cornice and Gutter Roof Drains:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.4, for cornice and gutter roof drains.
- 3. Body Material: Metal.
- 4. Dimension of Body: Nominal 6-inch diameter.
- 5. Outlet: Bottom or Side or 45-degree angle.
- 6. Dome Material: Bronze.
- 7. Vandal-Proof Dome: Required.

E. Metal, Parapet Roof Drains:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4, for parapet roof drains.
3. Body Material: Cast iron
4. Outlet: Back or Angle.
5. Grate Material: Cast iron.
6. Vandal-Proof Grate: Required.

F. Metal, Large-Sump, Promenade Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for promenade roof drains.
3. Body Material: Cast iron
4. Dimension of Body: Nominal 14-inch diameter.
5. Dimension of Frame and Grate: Nominal 14 inches square.
6. Outlet: Bottom.
7. Grate Material: Cast iron.
8. Vandal-Proof Grate: Required.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Sump Receiver Plate: Required.

G. Metal, Medium-Sump, Promenade Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for promenade roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: 11- to 12-inch diameter.
5. Dimension of Frame and Grate: Nominal 12 inches square.
6. Outlet: Bottom.
7. Grate Material: Cast iron.
8. Vandal-Proof Grate: Required.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Expansion Joint: Not required.
12. Sump Receiver Plate: Required.

H. Metal, Small-Sump, Promenade Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for promenade roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 8-inch diameter.
5. Dimension of Frame and Grate: Nominal 8 inches (203 mm) square.
6. Outlet: Bottom.
7. Grate Material: Cast iron.
8. Vandal-Proof Grate: Required.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Expansion Joint: Not required.
12. Sump Receiver Plate: Required.

I. Metal, Medium-Sump, Deck Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
3. Body Material: Metal.
4. Flange: Anchor with weep holes.
5. Clamping Device: Required.
6. Integral Backwater Valve: [Not required] [Required].
7. Outlet: Bottom End Side.
8. Grate Material: Cast iron.
9. Grate Finish: Not required.
10. Overall Dimension of Frame and Grate: Nominal 14 inches round square.
11. Top-Loading Classification: Heavy Duty.
12. Vandal-Proof Frame and Grate: Required.

J. Metal, Small-Sump, Deck Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
3. Body Material: Metal.
4. Flange: Not required.
5. Clamping Device: Required.
6. Integral Backwater Valve: Not required.
7. Outlet: Bottom End Side.
8. Grate Material: Cast iron.
9. Grate Finish: Not required.
10. Overall Dimension of Frame and Grate: Nominal 8 inches round square.
11. Top-Loading Classification: Heavy Duty.
12. Vandal-Proof Frame and Grate: Required.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Josam Company.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M, for cast-iron soil pipe with cast-iron ferrule hreaded, adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule Threaded, adjustable housing.
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with set-screws or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.

- d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
 - 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 or raised-head, drilled-and-threaded brass.
 - 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.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. ProSet Systems Inc.
- 2. Standard: ASTM E 814, for through-penetration firestop assemblies.
- 3. Size: Same as connected pipe.
- 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/A 48M, 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.

2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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 Sections.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 6 inches above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate cleanouts at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- K. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- L. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- M. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 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 the pipe size, with a minimum length of 10 inches and with 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.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, electric, storage, domestic-water heaters.
 - 2. Flow-control, electric, tankless, domestic-water heaters.
 - 3. Thermostat-control, electric, tankless, domestic-water heaters.
 - 4. Domestic-water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.
- D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.5 COORDINATION

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

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components Five years.
 - b. Electric, Tankless, Domestic-Water Heaters: Five year

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Water Heaters.
 - b. Bradford White Corporation.
 - c. Cemline Corporation.
 - d. Electric Heater Company (The).
 - e. GSW Water Heating.
 - f. HESco Industries, Inc.
 - g. Lochinvar Corporation.
 - h. Precision Boilers, Inc.
 - i. PVI Industries, LLC.
 - j. RECO USA.
 - k. Rheem Manufacturing Company.
 - l. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - m. State Industries.
 - n. Vaughn Manufacturing Corporation.

2. Standard: UL 1453.
3. Storage-Tank Construction: 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 glass linings
4. 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.
 - 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 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 domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics: as scheduled on the drawings.

2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

- A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Bosch Water Heating.
 - b. Chronomite Laboratories, Inc.
 - c. Eemax, Inc.
 - d. Stiebel Eltron, Inc.
 2. Standard: UL 499 for electric, tankless, domestic-water heater heating appliance.
 3. 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.
 - 4. Support: Bracket for wall mounting.
 - 5. Capacity and Characteristics: as scheduled on the drawings.
- B. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Bosch Water Heating.
 - b. Chronomite Laboratories, Inc.
 - c. E-Tankless Water Heaters Corp.
 - d. Keltech, Inc.
 - e. Niagara Industries, Inc.
 - 2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
 - 3. 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.
 - 4. Support: Bracket for wall mounting.
 - 5. Capacity and Characteristics: as scheduled on the drawings.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provided or comparable product by one of the following:
 - a. AMTROL Inc.
 - b. Flexcon Industries.
 - c. Honeywell International Inc.
 - d. Pentair Pump Group (The); Myers.
 - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - f. State Industries.
 - g. Taco, Inc.
- 2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

3. 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.
 4. Capacity and Characteristics: as scheduled on the drawings
- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and memory-stop balancing valves to provide balanced flow through each domestic-water heater.
1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 2. Comply with requirements for balancing valves specified in Division 22 Section "Domestic Water Piping Specialties."
- F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig maximum outlet pressure unless otherwise indicated.
- G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 8- inches above the floor.
- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Division 03 Section Cast-in-Place Concrete.
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. 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 concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches on wall bracket.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to substrate.
- C. Install electric, domestic-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.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install pressure relief valves in water piping for electric, domestic-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.
- F. 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 electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."
- G. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill electric, domestic-water heaters with water.
- J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train owner's maintenance personnel to adjust, operate, and maintain commercial and tankless electric, domestic-water heaters.

END OF SECTION 223300

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, atmospheric, gas-fired, storage, domestic-water heaters.
 - 2. Commercial, power-burner, gas-fired, storage, domestic-water heaters.
 - 3. Commercial, power-vent, gas-fired, storage, domestic-water heaters.
 - 4. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
 - 5. Domestic-water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each type of commercial, gas-fired domestic-water heater, from manufacturer.
- D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.
- H. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA 90.1 Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.5 COORDINATION

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

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: 5year(s).

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters:

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 Water Heaters.
 - b. Bock Water Heaters, Inc.
 - c. Bradford White Corporation.
 - d. GSW Water Heating.
 - e. HESco Industries, Inc.
 - f. Lochinvar Corporation.
 - g. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - h. State Industries.
2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Storage-Tank Construction: ASME-code steel with 150-psig (1035-kPa) working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) 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: Required 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. Burner: For use with atmospheric, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction.
6. Draft Hood: Draft diverter, complying with ANSI Z21.12.

B. Commercial, Power-Burner, Gas-Fired, Storage, Domestic-Water Heaters:

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. Aldrich Company, Inc. (The).
 - b. Bock Water Heaters, Inc.
 - c. HESco Industries, Inc.
 - d. Precision Boilers.
 - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - f. State Industries.
2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Storage-Tank Construction: Non-ASME-code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) 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: Required 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. Burner: UL 795 for power-burner, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-

pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction.

C. Commercial, Power-Vent, Gas-Fired, Storage, Domestic-Water Heaters:

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 Water Heaters.
 - b. Bradford White Corporation.
 - c. Lochinvar Corporation.
 - d. Rheem Manufacturing Company.
 - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - f. State Industries.
2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Storage-Tank Construction: ASME-code steel with 150-psig 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: Required 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. Burner: For use with power-vent, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

- j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - 5. Special Requirements: NSF 5 construction.
 - 6. Power-Vent System: Exhaust fan, interlocked with burner.
- D. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
- 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. AERCO International, Inc.
 - b. Ajax Boiler Inc.
 - c. American Water Heaters.
 - d. Bradford White Corporation.
 - e. Heat Transfer Products, Inc.
 - f. Lochinvar Corporation.
 - g. RBI Water Heaters; a Mestek company.
 - h. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - i. State Industries.
 - 2. Standard: ANSI Z21.10.3/CSA 4.3.
 - 3. Description: Manufacturer's proprietary design to provide at least 92 percent combustion efficiency at optimum operating conditions.
 - 4. 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.
 - 5. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required 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. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
- g. Temperature Control: Adjustable thermostat.
- h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
- i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

E. Capacity and Characteristics: As indicated on drawings

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

- 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. AMTROL Inc.
 - b. Flexcon Industries.
 - c. Honeywell International Inc.
 - d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - e. State Industries.
 - f. Taco, Inc.
- 2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- 3. 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.
- 4. Capacity and Characteristics: As indicated on drawings

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated memory-stop balancing valves to provide balanced flow through each domestic-water heater.
 - 1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 - 2. Comply with requirements for balancing valves specified in Division 22 Section "Domestic Water Piping Specialties."
- F. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
- G. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig (3.5-kPa) 2-psig (13.8-kPa) 5-psig (34.5-kPa) pressure rating as required to match gas supply.
- H. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- I. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
 - 2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.
- J. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
 - 2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.
- K. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
- L. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.
- M. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. 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 concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Install domestic-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.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters according to NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater

relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."
- F. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- G. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill domestic-water heaters with water.
- I. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Division 22 Section "Domestic Water Piping."
- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage domestic-water heaters.

END OF SECTION 223400

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Water closets.
 - 7. Urinals.
 - 8. Lavatories.
 - 9. Kitchen sinks.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 - 3. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. 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.
- E. PVC: Polyvinyl chloride plastic.

- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: 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.

1.5 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. Plastic Mop-Service Basins: ANSI Z124.6.
 - 2. Plastic Sinks: ANSI Z124.6.
 - 3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.

5. Stainless-Steel Residential Sinks: ASME A112.19.3.
 6. Vitreous-China Fixtures: ASME A112.19.2M.
 7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 8. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Faucets: ASME A112.18.1.
 2. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A112.6.3.
 2. Grab Bars: ASTM F 446.
 3. Hose-Coupling Threads: ASME B1.20.7.
 4. Off-Floor Fixture Supports: ASME A112.6.1M.
 5. Pipe Threads: ASME B1.20.1.
 6. Plastic Toilet Seats: ANSI Z124.5.
 7. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets:
1. 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. Hydrotek International, Inc. (BOD)
 - b. American Standard Companies, Inc.
 - c. Bradley Corporation.
 - d. Delta Faucet Company.
 - e. Elkay Manufacturing Co.
 - f. Kohler Co.
 - g. Moen, Inc.
 - h. Speakman Company.
 - i. American Standard Companies, Inc.
 - j. Broadway Collection.
 - k. Central Brass Manufacturing Company.
 - l. Delta Faucet Company.
 - m. Elkay Manufacturing Co.
 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: General-duty, copper or brass underbody with brass cover plate.
- b. Finish: Polished chrome plate.
- c. Maximum Flow Rate: 2.2 gpm.
- d. Centers: Adjustable.

2.2 SINK FAUCETS

A. Sink Faucets:

1. 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. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Delta Faucet Company.
 - d. Elkay Manufacturing Co.
 - e. Just Manufacturing Company.
 - f. Kohler Co.
 - g. Moen, Inc.
 - h. Speakman Company.
 - i. Zurn Plumbing Products Group; Commercial Brass Operation.
 - j. Hydrotek International, Inc.
2. Description: Kitchen faucet without spray. Include hot and cold water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: General-duty, copper or brass underbody with brass cover plate.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Single control.
 - e. Mounting: Deck.
 - f. Inlet(s): NPS 1/2 male shank.
 - g. Spout Type: Swing, round tubular.
 - h. Spout Outlet: Aerator.

2.3 LAMINAR-FLOW FAUCET-SPOUT OUTLETS

A. Laminar-Flow Faucet-Spout Outlets, <Insert drawing designation>:

1. 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. Chronomite Laboratories, Inc.
 - b. NEOPERL, Inc.
2. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating, laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.4 FLUSHOMETERS

A. Flushometers:

1. 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. Hydrotek International, Inc. (BOD)
 - b. Coyne & Delany Co.
 - c. Delta Faucet Company.
 - d. Sloan Valve Company.
 - e. Zurn Plumbing Products Group; Commercial Brass Operation.
 - f. Sloan Valve Company.
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: piston operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 1.
 - d. Trip Mechanism: Hard-wired, electric-sensor actuator.
 - e. Consumption: Gal./flush to match fixture.

2.5 TOILET SEATS

A. Toilet Seats:

1. 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. American Standard Companies, Inc.
 - b. Bemis Manufacturing Company.
 - c. Eljer.
 - d. Kohler Co.
 - e. Olsonite Corp.
 - f. Sanderson Plumbing Products, Inc.; Beneke Div.
 - g. Kohler Co.
2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic.
 - b. Configuration: Closed front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: CK, check SS, self-sustaining.
 - e. Class: Standard commercial.
 - f. Color: White.

2.6 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

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. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. 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:
 - a. TRUEBRO, Inc.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.7 FIXTURE SUPPORTS

- 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:
1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
1. Description: Combination carrier designed for accessible mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. 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.

D. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Sink Supports:

1. Description: Type III, sink carrier with hanger plate and exposed arms for sink-type fixture. Include steel uprights with feet.

2.8 WATER CLOSETS

A. Water Closets:

1. 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. Crane Plumbing, L.L.C./Fiat Products.
 - b. American Standard Companies, Inc.
 - c. Kohler Co.
2. Description Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: One piece.
 - 1) Bowl Type: Elongated with siphon-jet design.
 - 2) Design Consumption: 1.6 gal./flush.
 - 3) Color: White.
 - b. Supply: NPS 1/2 (DN 15) chrome-plated brass or copper.
 - c. Style: Flushometer valve.
 - 1) Bowl Type: Round front with siphon-jet design.
 - 2) Design Consumption: 1.6 gal./flush.
 - 3) Color: White.

2.9 URINALS

A. Urinals:

1. 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. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.

- c. Kohler Co.
- 2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Type: Siphon jet.
 - b. Strainer or Trapway: Integral trap.
 - c. Design Consumption: 1 gal./flush.
 - d. Color: White.
 - e. Supply Spud Size: NPS 3/4.
 - f. Outlet Size: NPS 1-1/2.
 - g. Flushometer: As specified.
 - h. Fixture Support: Urinal chair carrier.
- B. Urinals, <Insert drawing designation>:

2.10 LAVATORIES

- A. Lavatories:
 - 1. 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. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - 2. Description: Wall-mounting, vitreous-china fixture.
 - a. Type: With back.
 - b. Size: As indicated.
 - c. Faucet Hole Punching: Three holes, 2-inch centers.
 - d. Faucet Hole Location: Top.
 - e. Color: White.
 - f. Faucet: Lavatory as indicated.
 - g. Supplies: NPS 3/8 chrome-plated copper with stops.
 - h. Drain: Grid.
 - i. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/2 thick tubular brass waste to wall; and wall escutcheon.
 - j. Protective Shielding Guard(s): As specified.
 - k. Fixture Support: Lavatory.
- B. Lavatories:
 - 1. 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. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Eljer.

- e. Kohler Co.
 - f. Mansfield Plumbing Products, Inc.
 - g. Peerless Pottery, Inc.
 - h. St. Thomas Creations.
2. Description: Accessible, wall-mounting, vitreous-china fixture designed for people in wheelchairs.
- a. Type: Shelf back
 - b. Size: As indicated.
 - c. Faucet Hole Punching: As required.
 - d. Color: White.
 - e. Faucet: Lavatory for separate drain.
 - f. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
 - g. Drain: Grid.
 - h. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/2 thick tubular brass waste to wall; and wall escutcheon.
 - i. Fixture Support: Lavatory.

2.11 KITCHEN SINKS

A. Kitchen Sinks:

1. 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. Eljer.
 - b. Kohler Co.
 - c. American Standard Companies, Inc.
 - d. Dayton Products, Inc.
 - e. Elkay Manufacturing Co.
 - f. Just Manufacturing Company.
 - g. Moen, Inc.
2. Description: One-bowl, residential, counter-mounting, stainless-steel kitchen sink.
 - a. Overall Dimensions:
 - b. Metal Thickness: 0.038 inch.
 - c. Bowl:
 - 1) Dimensions: As indicated.
 - 2) Drain: 3-1/2-inch outlet for disposer.
 - a) Location: Centered in bowl.
 - d. Sink Faucet: As indicated.
 - e. Supplies: NPS 1/2 chrome-plated copper with stops.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch thick tubular brass waste to wall; and wall escutcheon(s).
 - g. Disposer: Optional.

2.12 SERVICE SINKS

A. Service Sinks:

1. 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. American Standard Companies, Inc.
 - b. Commercial Enameling Company.
 - c. Eljer.
 - d. Kohler Co.
 - e. Crane Plumbing, L.L.C./Fiat Products.
 - f. Eljer.
2. Description: Trap-standard- and wall-mounting, enameled, cast-iron fixture with roll-rim with two faucet holes in back and rim guard on front and sides.
 - a. Size: As indicated.
 - b. Color: White.
 - c. Faucet: Sink <Insert designation>.
 - d. Drain: Grid as specified.
 - e. Trap Standard: NPS 3 (DN 80) enameled, cast iron with cleanout and floor flange.
 - f. Fixture Support: Sink <Insert designation>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before 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.

3.2 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 counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: 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."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. 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.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install trap-seal liquid in dry urinals.
- P. 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.
- Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- R. 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.
- S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

- U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- V. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
- W. 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."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Section "Domestic Water Piping". 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."

3.4 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.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers, hot-water dispensers, and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

3.6 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.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following drinking fountains, water coolers, and related components:
 - 1. Drinking fountains.
 - 2. Pressure water coolers.
 - 3. Water-station water coolers.
 - 4. Remote water coolers.
 - 5. Fixture supports.

1.3 DEFINITIONS

- A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
- F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- G. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.

- D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains:
 - 1. 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. Elkay Manufacturing Co. (BOD)
 - b. Halsey Taylor.
 - c. Filtrine Manufacturing Company; Drinking Water Division.
 - d. Haws Corporation.
 - e. Most Dependable Fountains, Inc.
 - f. Murdock, Inc.
 - g. Oasis Corporation.
 - h. Stern-Williams Co., Inc.
 - i. Sunroc Corp.
 - 2. Description: Accessible, Style W, wall-mounting drinking fountain.

- a. Material: Stainless steel complying with ASME 112.19.2M for drinking fountains with backsplash.
- b. Receptor Shape: Rectangular.
- c. Back Panel: Stainless-steel wall plate behind drinking fountain.
- d. Bubblers: One, with adjustable stream regulator, located on deck.
- e. Control: Push bar.
- f. Supply: NPS 3/8 with ball, gate, or globe valve.
- g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
- h. Support: Type I, water cooler carrier. Refer to "Fixture Supports" Article.

2.2 PRESSURE WATER COOLERS

A. Water Coolers:

- 1. 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. Elkay Manufacturing Co. (BOD)
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Larco, Inc.
 - e. Oasis Corporation.
 - f. Sunroc Corp.
- 2. Description: ARI 1010, Type PB, pressure with bubbler, Style F, freestanding or Style FW, flush-to-wall water cooler.
 - a. Cabinet: All stainless steel.
 - b. Control: Push button.
 - c. Supply: NPS 3/8 with ball, gate, or globe valve.
 - d. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.

2.3 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.
- D. Set remote water coolers on floor, unless otherwise indicated.
- E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, mounting height to be 36" to the outlet of the bubbler unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Sections "Domestic Water Piping". 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."

3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.7 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

SECTION 226113 - COMPRESSED-AIR PIPING FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Compressed-air piping and specialties for nonmedical laboratory facilities, designated "laboratory air," operating at 85 psig.

1.3 DEFINITIONS

- A. Compressed-Air Piping Systems: Include laboratory air piping systems.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Compressed-air tubes and fittings.
 - 2. Compressed-air valves.
- B. Piping Material Certification: Signed by Installer certifying that lab compressed-air piping materials comply with NFPA 99 requirements.
- C. Brazing certificates.
- D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Lab Compressed-Air Piping Systems for Laboratory Facilities.
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Laboratory Compressed-Air Service(s): Do not interrupt laboratory compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify UMD Construction Manager no fewer than 10 days in advance of proposed interruption of laboratory compressed-air service(s).
 - 2. Do not proceed with interruption of laboratory compressed-air service(s) without UMD Construction Manager's written permission.

1.7 COORDINATION

- A. Coordinate lab compressed-air service connections with other service connections. Lab vacuum service connections are specified in Division 22 Section "Vacuum Piping for Laboratory and Facilities".

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Copper Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for gas service.
 - 1. General Requirements for Copper Fittings: Manufacturer cleaned, purged and sealed.
 - 2. Wrought-Copper Fittings: ASME B16.22, brazed-joint pressure type L or MSS SP-73, with dimensions for brazed joints.
 - 3. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.

2.2 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.3 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged sealed.
- B. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo.
 - b. Crane
 - c. Milwaukee

- d. Amico Corporation.
- e. NIBCO INC.
- 2. Pressure Rating: 300 psig minimum.
- 3. Ball: Full-port, stainless steel.
- 4. Seats: PTFE or TFE.
- 5. Handle: Lever
- 6. Stem: Blowout proof with PTFE or TFE seal.
- 7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

2.4 NITROGEN

- A. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cleaning of Lab Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
 - 1. Clean Lab gas tube and fittings, valves, gages, and other components of oil, grease."

3.2 PIPING APPLICATIONS

- A. Laboratory Air Piping: Use the following piping materials for each size range:
 - 1. NPS 2 and Smaller: Type L, copper Lab gas tube; wrought-copper fittings; and brazed joints.
- B. Drain Piping: Use the following piping materials:
 - 1. Copper water tube, cast- or wrought-copper fittings, and brazed joints.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping.
- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and specialties to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.
- H. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- I. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- J. Install piping to permit valve servicing.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.

3.4 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain so contents spill over or into it.

3.5 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- B. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
- D. Support horizontal piping within 12 inches of each fitting and coupling.

- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/8 and NPS 1/2 : 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 3/4: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 1: 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 5. NPS 1-1/4: 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
- G. Install supports for vertical copper tubing every 10 feet

3.7 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for nonmedical laboratory compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for lab compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Laboratory Air: Black letters on yellow-and-white checkerboard background.

3.8 FIELD QUALITY CONTROL FOR COMPRESSED-AIR PIPING IN NONMEDICAL LABORATORY FACILITIES

- A. Engage qualified testing agency to perform field tests and inspections of compressed-air piping in nonmedical laboratory facilities and prepare test reports. Test to include date, start time and initial pressure, end time and final pressure. Test to be witnessed by owner's representative.
- B. Perform tests and inspections of compressed-air piping in nonmedical laboratory facilities and prepare test reports.
- C. Tests and Inspections:
 - 1. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 2. Repair leaks and retest until no leaks exist.

END OF SECTION 226113

SECTION 226213 - VACUUM PIPING FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Laboratory high-vacuum piping and specialties, designated "laboratory high vacuum" operating at 24 inches mercury to 29 inches mercury.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Vacuum pipes and fittings.

1.4 PROJECT CONDITIONS

- A. Interruption of Existing Laboratory Vacuum Service(s): Do not interrupt laboratory vacuum service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify UMD Construction Manager no fewer than 10 days in advance of proposed interruption of laboratory vacuum service(s).
 - 2. Do not proceed with interruption of laboratory vacuum service(s) without UMD Construction Manager's written permission.

1.5 COORDINATION

- A. Coordinate vacuum service connections with other service connections. Lab compressed-air service connections are specified in Division 22 Section "Compressed-Air Piping for Laboratory.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:

1. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification"

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Copper Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for gas.
 1. General Requirements for Copper Fittings: Manufacturer cleaned, purged and sealed.
 2. Wrought-Copper Fittings: ASME B16.22, brazed-joint pressure type or MSS SP-73, with dimensions for brazed joints.
 3. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Viega; Plumbing and Heating Systems.

2.2 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.3 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged and sealed.
- B. Copper-Alloy Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo
 - b. Crane
 - c. Milwaukee
 - d. Amico Corporation.
 - e. NIBCO INC.
 2. Pressure Rating: 300 psig minimum.
 3. Ball: Full-port, stainless steel.
 4. Seats: PTFE or TFE.
 5. Handle: Lever
 6. Stem: Blowout proof with PTFE or TFE seal.
 7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

2.4 NITROGEN

- A. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cleaning of Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
 - 1. Clean gas tube and fittings, valves, gages, and other components of oil, grease, and seal end.

3.2 PIPING APPLICATIONS

- A. Nonhealthcare Laboratory High Vacuum Piping: Use the following piping materials for each size range:
 - 1. NPS 2 and Smaller: Type L, copper gas tube; wrought-copper fittings; and brazed joints.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Comply with ASSE Standard #6010 for installation of vacuum piping.
- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- C. Install vacuum and drain piping with 1 percent slope downward in direction of flow.
- D. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications below unless otherwise indicated.
- E. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- F. Provide drain leg and drain trap at end of each main and branch and at low points.
- G. Install piping to permit valve servicing.
- H. Install piping free of sags and bends.

3.4 VALVE APPLICATIONS

- A. Valves for Copper Vacuum Tubing: Use copper alloy ball and bronze check types.

3.5 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.

3.6 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
- D. Base of Vertical Piping: MSS Type 52, spring hangers.
- E. Support horizontal piping within 12 inches of each fitting and coupling.
- F. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/8 and NPS 1/2 : 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 3/4 : 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 1 : 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
- H. Install supports for vertical copper tubing every 10 feet (3 m).

3.8 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for lab vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.

3.9 FIELD QUALITY CONTROL FOR LABORATORY FACILITY NONMEDICAL VACUUM PIPING

- A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of vacuum piping in nonmedical laboratory facilities. Test to include date, start time and initial pressure, end time and final pressure. Test to be witnessed by owner's representative.
- B. Tests and Inspections:
 - 1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - a. Test Pressure for Copper Tubing: 150 psig.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect filters for proper operation.
- C. Prepare test reports.

END OF SECTION 226213

SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall piping.
 - 2. Piping specialties.

1.3 DEFINITIONS

- A. FPM: Vinylidene fluoride (hexafluoropropylene copolymer rubber).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For neutralization system.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of neutralization-system assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Profile Drawings for Outdoor Underground Piping: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate underground structures and pipes. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Pipe sizes, locations, and elevations.
 - 2. Other piping in same trench and clearances from sewerage system piping.

3. Interface and spatial relationship between piping and proximate structures.
 - C. Field quality-control reports.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
 - B. Do not store plastic pipe or fittings in direct sunlight.
 - C. Protect pipe, fittings, and seals from dirt and damage.
- 1.7 FIELD CONDITIONS
- A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service in accordance with requirements indicated:
 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of chemical-waste service.
 2. Do not proceed with interruption of chemical-waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

- 2.1 SYSTEM DESCRIPTION
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - B. NFPA Compliance: Comply with NFPA 70.
- 2.2 PERFORMANCE REQUIREMENTS
- A. Single-Wall Piping Pressure Rating: 5-psig of water for 30 minutes.
- 2.3 SINGLE-WALL PIPE AND FITTINGS
- A. PP Drainage Pipe and Fittings: ASTM F1412, extruded pipe and drainage-pattern fittings molded, with Schedule 40 dimensions and with fire-retardant additive complying with ASTM D4101; with fusion and mechanical joint ends.
 1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
 2. Manufacturers:

- a. GF Piping Systems
 - b. IPEX USA LLC
 - c. Orion Fittings; a Watts brand
 - d. Zurn Industries, LLC
 3. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.
- B. PVDF Drainage Pipe and Fittings: ASTM F1673, Schedule 40, pipe and drainage-pattern fittings. Include fittings with fusion and mechanical joint joint ends.
1. Manufacturers:
 - a. GF Piping Systems
 - b. IPEX USA LLC
 - c. Orion Fittings; a Watts brand
 - d. Zurn Industries, LLC
 2. Source Limitations: Obtain pipe and fittings from single source from single manufacturer.
- C. Adapters and Transition Fittings: Assemblies with combinations of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

2.4 JOINING MATERIALS

- A. Couplings: Assemblies with combinations of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
- B. Adapters and Transition Fittings: Assemblies with combinations of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.
- C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

2.5 PIPING SPECIALTIES

- A. Plastic Dilution Traps:
1. Manufacturers:
 - a. GF Piping Systems
 - b. IPEX USA LLC.
 - c. Orion Fitting; a Watts brand
 - d. Zurn Industries, LLC
 2. Source Limitations: Obtain traps from single source from single manufacturer.
 3. Material: Corrosion-resistant PP, with removable base.
 4. End Connections: Mechanical joint.
 5. Dilution Tanks: 1-gal. capacity, with clear base unless colored base is indicated; with two NPS 1-1/2 top inlets and one NPS 1-1/2 side outlet.
 6. Small Dilution Jars: 1-pint capacity, with clear base unless colored base is indicated; with NPS 1-1/2 top inlet and NPS 1-1/2 side outlet.
 7. Large Dilution Jars: 1-quart capacity; with NPS 1-1/2 top inlet and NPS 1-1/2 side outlet.

B. Corrosion-Resistant Traps:

1. Type: P-trap or drum trap.
2. Size: NPS 1-1/2 or NPS 2, as required to match connected piping.
3. High-Silicon Iron: ASTM A861, with horizontal outlet and hub-and-plain or plain ends to match connecting piping.
4. PP: ASTM D4101, with mechanical-joint pipe connections.
5. PVDF: ASTM D3222, with mechanical-joint pipe connections.

C. PP Floor Drains:

1. Manufacturers:
 - a. GF Piping Systems
 - b. IPEX USA LLC.
 - c. Orion Fitting; a Watts brand
 - d. Zurn Industries, LLC
2. Source Limitations: Obtain floor drains from single source from single manufacturer.
3. Body: With 7- to 9-inch top diameter, with flashing flange and weep holes; and with basket strainer and trap-primer connection.
4. Outlet: Bottom, to match connecting pipe, with NPS 2, NPS 3, NPS 4, or NPS 6 outlet as indicated.

D. Plastic Backwater Valves:

1. Description: Full-port NPS 3 check valve, PP or PVDF, matching or compatible with system piping and compatible with system liquid, with EPDM seals and flanged ends.

E. PP Sink Outlets:

1. Description: NPS 1-1/2, with clamping device, stopper, and 7-inch- high overflow fitting.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Chemical-Waste Piping Inside the Building:

1. Install piping adjacent to equipment, accessories, and specialties, to allow space for service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping unless otherwise indicated.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. 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.
6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.
10. Verify final equipment locations for roughing-in.
11. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
12. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
13. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 PIPING SPECIALTY INSTALLATION

- A. Embed floor drains in 4-inch- minimum depth of concrete around bottom and sides. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for concrete.
- B. Fasten grates to drains if indicated.
- C. Set floor drains with tops flush with pavement surface.
- D. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use fittings of same material as sewer pipe at branches for cleanouts and riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.
 1. Set cleanout bodies in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement, with tops flush with pavement surface. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.
- E. Install backwater valves in horizontal position. Include riser to cleanout at grade.

3.3 JOINT CONSTRUCTION

- A. Chemical-Waste Piping Inside the Building:
 1. Plastic-Piping Fusion Joints: Make PP drainage-piping joints in accordance with ASTM F1290.
 2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe sizes in this article refer to aboveground single-wall piping.

- B. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Vertical Piping: MSS Type 8 or MSS Type 42 riser 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.
- D. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for installation of supports.
- E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- F. Support vertical piping and tubing at base and at each floor.
- G. Rod diameter may be reduced one size for double-rod hangers, to minimum of 3/8 inch.
- H. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2: 33 inches with 3/8-inch rod.
 - 2. NPS 2-1/2 and NPS 3: 42 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: 48 inches with 7/8-inch rod.
- I. Install supports for vertical PP piping every 72 inches.
- J. Install vinyl-coated hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. All Sizes: Install continuous support for piping with liquid waste at temperatures above 140 deg F.
 - 2. NPS 1/2 and Smaller: 30 inches with 3/8-inch rod.
 - 3. NPS 3/4 to NPS 1-1/2: 36 inches with 3/8-inch rod.
 - 4. NPS 2: 36 inches with 3/8-inch rod.
 - 5. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 7. NPS 6: 48 inches with 3/4-inch rod.
- K. Install supports for vertical PVDF piping NPS 1-1/2 every 48 inches and NPS 2 and larger every 72 inches.

- L. Support piping and tubing not listed above in accordance with MSS SP-58.

3.5 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make connections to existing piping, so finished Work complies as nearly as practical with requirements specified for new Work.
- C. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.6 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for labeling of equipment and piping.
 - 1. Use warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.7 ADJUSTING

- A. Adjust neutralization-system set points.

3.8 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Clean piping by flushing with potable water.

3.9 FIELD QUALITY CONTROL

- A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.
 - 1. Defects requiring correction include the following:

- a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Hydrostatic Tests for Drainage Piping:
 - 1) Allowable leakage is a maximum of 50 gal./inch of nominal pipe size per mile of pipe during 24-hour period.
 - 2) Close openings in system and fill with water.
 - 3) Purge air and refill with water.
 - 4) Disconnect water supply.
 - 5) Test and inspect joints for leaks.
 - e. Air Tests for Drainage Piping: Comply with UNI-B-6.
- 2. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Submit separate reports for each test.
- B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.
- C. Chemical-waste piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.
- B. Substitution request: Substitution requests must be accompanied by a chemical compatibility analysis and be made to the Construction manager in writing.
- C. Single-Wall, Chemical-Waste Sewerage Piping: Use any of the following piping materials for each size range:
- 1. NPS 1-1/2 to NPS 4: PP drainage pipe and fittings and fusion joints.
 - 2. NPS 1-1/2 to NPS 4: PVDF drainage pipe and fittings and fusion joints.
 - 3. NPS 6: PP drainage pipe and fittings and fusion joints.
 - 4. NPS 6: PVDF drainage pipe and fittings and fusion joints.
 - 5. NPS 8 to NPS 12: PP drainage pipe and fittings and fusion joints.
 - 6. NPS 8 to NPS 12: PVDF drainage pipe and fittings and fusion joints.
- D. Aboveground Chemical-Waste Piping: Use any of the following piping materials for each size range:
- 1. NPS 1-1/2 to NPS 6 : PP drainage piping and fusion joints.
 - 2. NPS 1-1/2 to NPS 6 : PVDF drainage piping and fusion joints.

- E. Under Slab-on-Grade, Indoor, Chemical-Waste Piping: Use any of the following piping materials for each size range:
1. NPS 1-1/2 to NPS 6 : PP drainage piping and fusion joints.
 2. NPS 1-1/2 to NPS 6 : PVDF drainage piping and fusion joints.

END OF SECTION 226600

SECTION 226713 - PROCESSED WATER PIPING FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes reagent-water, deionized-water, distilled-water and reverse-osmosis-water piping, fittings, and valves, including the following:
 - 1. PP pipe and fittings for heat-fusion joints.
 - 2. PP pipe and fittings for electro-fusion joints.
 - 3. PP valves.

1.3 DEFINITIONS

- A. RO: Reverse osmosis.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.3 for piping conveying fluid at a pressure of 15 psig or greater.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings:
 - 1. Reagent-Water Piping: 50 psig unless otherwise indicated.
 - 2. Deionized-Water Piping: 100 psig unless otherwise indicated.
 - 3. Distilled-Water Piping: 100 psig unless otherwise indicated.
 - 4. RO Water Piping: 100 psig unless otherwise indicated.

2.2 PLASTIC PIPE AND FITTINGS

- A. Standards: Comply with NSF 14, NSF 61, and NSF 372.
- B. PP Pipe and Fittings for Heat-Fusion Joints: Made from ASTM D4101 PP resin.
 - 1. Manufacturers:
 - a. GF Piping Systems
 - b. IPEX USA LLC.
 - c. NIBCO Inc.
 - d. Orion Fittings; A Watts Brand
- C. PP Pipe and Fittings, Schedule 40: Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.
- D. PP Pipe and Fittings for Electro-Fusion Joints: Made from ASTM D4101 PP resin.
 - 1. Manufacturers:
 - a. IPEX USA LLC.
 - b. NIBCO Inc.
 - c. Orion Fittings; A Watts Brand
 - 2. PP Pipe and Fittings, Schedule 80: Schedule 80 or SDR dimensions; with socket fittings matching pipe dimensions.
 - 3. Electro-Fusion Fitting: Electrical-resistance heating coil for PP piping joints.

2.3 TRANSITION FITTINGS

- A. Couplings, flanges, or other manufactured fittings; same size as, with pressure rating at least equal to, and ends compatible with piping to be joined.

2.4 PP VALVES

- A. PP Ball Valves:
 - 1. Manufactures:
 - a. GF Piping Systems
 - b. Nibco Inc.

- c. Orion Fittings: a Watts brand
- d. Plast-O-Matic Valves, Inc.
- e. Thermoplastic Valves, Inc.
- 2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig at 73 deg F.
 - c. Body Material: ASTM D4101 PP resin.
 - d. Body Design: Union type.
 - e. End Connections: Detachable, butt or socket.
 - f. Ball: ASTM D4101 PP resin.
 - g. Port: Full.
 - h. Seats: PTFE.
 - i. Stem: ASTM D4101 PP resin.
 - j. Stem Seals: FKM-rubber O-rings.
 - k. Handle: Tee shaped.

B. PP Butterfly Valves:

- 1. Manufactures:
 - a. GF Piping Systems
 - b. Nibco Inc.
 - c. Orion Fittings: a Watts brand
 - d. Plast-O-Matic Valves, Inc.
 - e. Thermoplastic Valves, Inc.
- 2. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: ASTM D4101 PP resin.
 - c. Body Design: wafer type.
 - d. Seat: FKM rubber.
 - e. Disc: ASTM D4101 PP resin.
 - f. Stem: Stainless steel.
 - g. Stem Seals: FKM-rubber O-rings.
 - h. Handle: Lever type with locking device.

C. PP Ball-Check Valves:

- 1. Manufactures:
 - a. GF Piping Systems
 - b. Nibco Inc.
 - c. Orion Fittings: a Watts brand
 - d. Plast-O-Matic Valves, Inc.
 - e. Thermoplastic Valves, Inc.
- 2. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: ASTM D4101 PP resin.
 - c. Body Design: Union type.
 - d. End Connections: Detachable, socket.
 - e. Ball: ASTM D4101 PP resin.

- f. Seat and Seals: FKM-rubber O-rings.

D. PP Swing-Check Valves:

- 1. Manufactures:
 - a. GF Piping Systems
 - b. Nibco Inc.
 - c. Orion Fittings: a Watts brand
 - d. Plast-O-Matic Valves, Inc.
 - e. Thermoplastic Valves, Inc.
- 2. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: ASTM D4101 PP resin.
 - c. Body Design: Bolted-bonnet type.
 - d. End Connections: Flanged.
 - e. Shaft: ASTM D4101 PP resin.
 - f. Disc and Arm: ASTM D4101 PP resin.
 - g. Gasket and Seals: FKM rubber.

E. PP Diaphragm Valves:

- 1. Manufactures:
 - a. GF Piping Systems
 - b. Nibco Inc.
 - c. Orion Fittings: a Watts brand
 - d. Plast-O-Matic Valves, Inc.
 - e. Thermoplastic Valves, Inc.
- 2. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: ASTM D4101 PP resin.
 - c. Body Design: Bolted-bonnet type.
 - d. End Connections for NPS 2 and Smaller: Detachable, socket.
 - e. End Connections for NPS 2-1/2 and NPS 3: Flanged.
 - f. Diaphragm: FKM rubber.
 - g. Seals: FKM-rubber O-rings.
 - h. Handle: Wheel type.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. General Locations and Arrangements: Drawing and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for removal of ceiling panel, and coordinate with other services occupying that space.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Install piping to permit valve servicing.
- G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure ratings unless otherwise indicated.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.

3.2 JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. PP Piping Electro-Fusion Joints: Make in accordance with ASTM F1290.
- C. PP Piping Heat-Fusion Joints: Make in accordance with ASTM D2657.
- D. Join dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

3.3 INSTALLATION OF VALVES

- A. Install sectional valves close to mains on each branch and riser serving equipment.
- B. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access, and provide separate support where necessary.
- D. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.
- E. Install plastic valves of the same material as the plastic pipe in which they are installed.
- F. Install valves in horizontal piping with stem at or above center of pipe.

- G. Install valves in position to allow full movement of stem and lever handle.
- H. Install swing-check valves in horizontal position with the hinge pin level.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Clamps for Vertical Piping: MSS Type 8 or Type 42.
 - 6. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1 adjustable 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.
 - 7. Multiple, Straight, Horizontal Piping Runs, 100 Feet or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for stainless steel tubing with the maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally-enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install padded hangers for PP piping with maximum horizontal spacing and minimum rod diameters to comply with manufacturer's written recommendations, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install padded hangers for glass piping with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, manufacturer's written recommendations, locally enforced codes, and authorities having jurisdiction, whichever are most stringent.
- E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- F. Support vertical runs of stainless steel piping to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PP piping to comply with manufacturer's written recommendations, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- H. Support vertical runs of glass piping to comply with MSS SP-58, manufacturer's written recommendations, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- C. Connect deionized-water, distilled-water and/or RO water piping to equipment and service outlets with unions or flanges.

3.6 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 22 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Tests and Inspections:
 - 1. Test new piping and parts of existing piping that have been altered, extended, or repaired for leaks and defects.
 - 2. Schedule tests and their inspections by Owner, with at least 24 hours' advance notice.
 - 3. Do not cover piping or put into service before inspection and approval by the Owner.
 - 4. Test completed piping in accordance with Owner. In addition to any Owner requirements, perform tests as follows:
 - a. Hydrostatic Tests: Test piping at pressure of not less than 1-1/2 times the maximum system operating pressure, but not less than 100 psig. Hold test for four hours; pressure shall remain constant without pumping. Inspect system to determine visible leaks or significant pressure variations.
 - 5. If piping does not pass the test, replace leaking joints with new materials and retest until no leaks exist.
 - 6. Submit separate reports for each test.
- E. Processed-water system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.8 CLEANING OF PIPING SERVING LABORATORIES

- A. Use procedures prescribed by Owner or, if not prescribed, use procedures described below:

1. Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.
 2. Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.
 3. Provide storage tank(s), heat exchanger(s) and pumping system(s) required for cleaning.
 4. Clean piping by pumping at a sufficient velocity and quantity to dislodge sediment or dirt with sodium hypochlorite and deionized, distilled and RO water mixture throughout the system.
 5. Open all taps until cleaning solution is detected, then close taps. Retain solution in the system at least three hours.
- B. At the end of the retention period, open all faucets and taps to thoroughly flush with clean reagent, deionized, distilled and RO water until solution is drained from the system.

3.9 PIPING APPLICATION

- A. Transition and special fittings with pressure ratings at least equal to piping, and of same or compatible material, may be used in applications below.
- B. Pipe fittings shall be the same material as the piping to which it is connected.
- C. Substitution request: Substitution requests must be accompanied by a chemical compatibility analysis and be made to the Construction manager in writing.
- D. Reagent-Water Piping: Use any of the following piping materials for each pipe size range:
1. Pipe Sizes NPS 3: PP pipe and fittings and heat-fusion joints.
- E. Deionized-Water (DI); RO; and RO/DI Piping: Use any of the following piping materials for each pipe size range:
1. NPS 3: PP pipe and fittings and electro-fusion joints.
- F. Distilled-Water Piping: Use any of the following piping materials for each pipe size range:
1. NPS 3: PP pipe and fittings and electro-fusion joints.

3.10 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Valves shall be the same material as the piping to which they are connected.
 2. Shutoff Duty: Install ball valves in piping NPS 2 and smaller. Install butterfly or diaphragm valves for NPS 3 piping.
 3. Throttling Duty: Install ball valves in piping NPS 2 and smaller. Install diaphragm valves for NPS 3 piping.

END OF SECTION 226713