

This Product MasterSpec Section is licensed by ARCOM to Mueller Industries, Inc. ("Licensee").

This Product MasterSpec Section modifies the original MasterSpec text, and does not include the full content of the original MasterSpec Section.

Revisions made to the original MasterSpec text are made solely by the Licensee and are not endorsed by, or representative of the opinions of, ARCOM or The American Institute of Architects (AIA). Neither AIA nor ARCOM are liable in any way for such revisions or for the use of this Product MasterSpec Section by any end user. A qualified design professional should review and edit the document to suit project requirements.

For more information, contact Mueller Streamline Co., 8285 Tournament Drive, Memphis, TN 38125; Phone: 800-846-9750; Website: www.muellerindustries.com; Email: nagreene@muellerindustries.com.

For information about MasterSpec contact ARCOM at (800) 424-5080 or visit www.MasterSpec.com.

SECTION 221116 - DOMESTIC WATER PIPING

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

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. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Galvanized steel pipe and fittings.
4. Stainless-steel piping
5. CPVC piping.
6. PEX tube and fittings.
7. PEX-AL-PEX tube and fittings.
8. PEX-AL-HDPE tube and fittings.
9. PVC pipe and fittings.
10. PP pipe and fittings.

11. Piping joining materials.
12. Encasement for piping.
13. Transition fittings.
14. Dielectric fittings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping[**and water meters**] outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD 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 [Architect] [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of water service.
2. Do not interrupt water service without [Architect's] [Construction Manager's] [Owner'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.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

- C. Comply with NSF Standard 372 for low lead.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: [ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)] [and] [ASTM B 88, Type M (ASTM B 88M, Type C)] water tube, drawn temper.
1. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
 3. Copper Pressure-Seal-Joint Fittings: ASME B16.51, copper press-connect pressure fittings.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mueller Industries, Inc. Streamline PRS™ copper press fittings or a comparable product by one of the following:
 - 1) Elkhart Products Corporation.
 - 2) Viega LLC.
 - 3) <Insert manufacturer's name>.
 - b. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper or bronze fitting with EPDM-rubber O-ring seal in each end.
 - c. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Wrought-copper or bronze fitting with stainless-steel grip ring and EPDM-rubber O-ring seal in each end.
- B. Soft Copper Tube: [ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)] water tube, annealed temper.
1. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
 3. Copper Pressure-Seal-Joint Fittings: ASME B16.51, copper press-connect pressure fittings.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mueller Industries, Inc. Streamline PRS™ copper press fittings or a comparable product by one of the following:
 - 1) Elkhart Products Corporation.
 - 2) Viega LLC.
 - 3) <Insert manufacturer's name>.
 - b. Fittings for NPS 1-1/4 (DN 32) and Smaller: Wrought-copper or bronze fitting with EPDM-rubber O-ring seal in each end.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- D. Copper Unions:
1. MSS SP-123.
 2. Cast-copper-alloy, hexagonal-stock body.

3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

E. Copper Push-on-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Products Corporation.
 - b. Victaulic Company.
 - c. **<Insert manufacturer's name>**.
2. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

F. Copper-Tube, Extruded-Tee Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. T-DRILL Industries Inc.
 - b. **<Insert manufacturer's name>**.
2. Description: Tee formed in copper tube according to ASTM F 2014.

G. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products USA Inc.
 - d. Victaulic Company.
 - e. **<Insert manufacturer's name>**.
2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or ASTM B 584 bronze castings.
3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: **300 psig (2070 kPa)**.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

H. Appurtenances for Grooved-End, Ductile-Iron Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Shurjoint Piping Products USA Inc.
 - b. Smith-Cooper International.
 - c. Star Pipe Products.
 - d. Victaulic Company.
 - e. **<Insert manufacturer's name>.**
2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.

3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:

- a. AWWA C606 for ductile-iron-pipe dimensions.
- b. Ferrous housing sections.
- c. EPDM-rubber gaskets suitable for hot and cold water.
- d. Bolts and nuts.
- e. Minimum Pressure Rating:

- 1) **NPS 14 to NPS 18 (DN 350 to DN 450): [250 psig (1725 kPa)] <Insert value>.**
- 2) **NPS 20 to NPS 46 (DN 500 to DN 900): [150 psig (1035 kPa)] <Insert value>.**

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, [**Type E**] <Insert type>, [**Grade B**] <Insert grade>, Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products USA Inc.
 - d. Victaulic Company.
 - e. <Insert manufacturer's name>.
2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
3. Fittings for Grooved-End, Galvanized-Steel Pipe:

- a. AWWA C606 for steel-pipe dimensions.
- b. Ferrous housing sections.
- c. EPDM-rubber gaskets suitable for hot and cold water.
- d. Bolts and nuts.
- e. Minimum Pressure Rating:
 - 1) **NPS 8 (DN 200)** and Smaller: [**600 psig (4137 kPa)**] <Insert value>.
 - 2) **NPS 10 and NPS 12 (DN 250 to DN 300)**: [**400 psig (2758 kPa)**] <Insert value>.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**: [**250 psig (1725 kPa)**] <Insert value>.

2.5 STAINLESS-STEEL PIPING

- A. Potable-water piping and components shall comply with NSF 61 Annex G.
- B. Stainless-Steel Pipe: ASTM A 312/A 312M, [**Schedule 10**] [**and**] [**Schedule 40**].
- C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.
- D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products USA Inc.
 - d. Victaulic Company.
 - e. <Insert manufacturer's name>.
 2. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
 3. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
 - a. AWWA C606 for stainless-steel-pipe dimensions.
 - b. Stainless-steel housing sections.
 - c. Stainless-steel bolts and nuts.
 - d. EPDM-rubber gaskets suitable for hot and cold water.
 - e. Minimum Pressure Rating:
 - 1) **NPS 8 (DN 200)** and Smaller: [**600 psig (4137 kPa)**] <Insert value>.
 - 2) **NPS 10 and NPS 12 (DN 250 to DN 300)**: [**400 psig (2758 kPa)**] <Insert value>.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**: [**250 psig (1725 kPa)**] <Insert value>.

2.6 CPVC PIPING

- A. CPVC Pipe: ASTM F 441/F 441M, [**Schedule 40**] [**and**] [**Schedule 80**].
 - 1. CPVC Socket Fittings: [**ASTM F 438 for Schedule 40**] [**and**] [**ASTM F 439 for Schedule 80**].
 - 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.7 PEX TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Apollo Valves; Conbraco Industries, Inc.
 - 2. Elkhart Products Corporation.
 - 3. FlorHeat Company (The).
 - 4. Heat Innovations Inc.
 - 5. HeatLink Group Inc.
 - 6. Infloor Radiant Heating Inc.
 - 7. IPEX USA LLC.
 - 8. MrPex Systems Inc.
 - 9. REHAU.
 - 10. Uponor.
 - 11. Vanguard Piping Systems, Inc.
 - 12. Viega LLC.
 - 13. Warmboard, Inc.
 - 14. Watts Radiant; a Watts Water Technologies company.
 - 15. Zurn Industries, LLC.
 - 16. **<Insert manufacturer's name>**.
- B. Tube Material: PEX plastic according to ASTM F 876[**and ASTM F 877**].
- C. Fittings: [**ASTM F 1807, metal insert and copper crimp rings**] [**ASTM F 1960, cold expansion fittings and reinforcing rings**].
- D. Fittings: ASSE 1061, push-fit fittings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. SharkBite.
 - b. Zurn Industries, LLC.
 - c. **<Insert manufacturer's name>**.
- E. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 876; with plastic or corrosion-resistant-metal valve for each outlet.

2.8 PEX-AL-PEX TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Heat Innovations Inc.
 - 2. IPEX USA LLC.
 - 3. Uponor.
 - 4. Viega LLC.
 - 5. Watts Radiant; a Watts Water Technologies company.
 - 6. **<Insert manufacturer's name>.**
- B. Tube Material: PEX plastic bonded to the inside and outside of a welded aluminum tube according to ASTM F 1281.
- C. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at **104 deg F (40 deg C)** according to DIN 4726.
- D. Fittings: ASTM F 1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).

2.9 PEX-AL-HDPE TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Uponor.
 - 2. Viega LLC.
 - 3. Watts Radiant; a Watts Water Technologies company.
 - 4. **<Insert manufacturer's name>.**
- B. Tube Material: ASTM F 1986 tubing.
- C. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions

2.10 PVC PIPE AND FITTINGS

- A. PVC Pipe: ASTM D 1785, [**Schedule 40**] [**and**] [**Schedule 80**].
- B. PVC Socket Fittings: [**ASTM D 2466 for Schedule 40**] [**and**] [**ASTM D 2467 for Schedule 80**].
- C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.11 PP PIPE AND FITTINGS

- A. PP Pipe: ASTM F 2389, [**SDR 7.4**] [**and**] [**SDR 11**].

- B. PVC Socket Fittings: ASTM F 2389.

2.12 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- C. Solder Filler Metals: ASTM B 32, lead-free alloys.

- D. Flux: ASTM B 813, water flushable.

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

- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

1. Adhesive primer shall have a VOC content of 550 g/L or less.
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Solvent cement shall have a VOC content of 490 g/L or less.
4. Solvent cement shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less.
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Solvent cement shall have a VOC content of 510 g/L or less.
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.13 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: **[Sheet]** **[or]** **[tube]**.
- C. Color: **[Black]** **[or]** **[natural]** **<Insert color>**.

2.14 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 Mfg. Co.
 - b. Dresser, Inc.
 - c. Ford Meter Box Company, Inc. (The).
 - d. Jay R. Smith Mfg. Co.
 - e. JCM Industries, Inc.
 - f. Romac Industries, Inc.
 - g. Smith-Blair, Inc.
 - h. Viking Johnson.
 - i. **<Insert manufacturer's name>**.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - d. Uponor.
 - e. **<Insert manufacturer's name>**.
 - 2. Description:
 - a. **[CPVC]** **[or]** **[PVC]** one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

- b. One end with threaded brass insert and one solvent-cement-socket[**or threaded**] end.

E. Plastic-to-Metal Transition Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
 - d. **<Insert manufacturer's name>**.
- 2. Description:
 - a. **[CPVC] [or] [PVC]** four-part union.
 - b. Brass[**or stainless-steel**] threaded end.
 - c. Solvent-cement-joint[**or threaded**] plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.15 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. Central Plastics Company.
 - d. HART Industrial Unions, LLC.
 - e. Jomar Valve.
 - f. Matco-Norca.
 - g. Watts; a Watts Water Technologies company.
 - h. Wilkins.
 - i. Zurn Industries, LLC.
 - j. **<Insert manufacturer's name>**.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: [**125 psig (860 kPa) minimum at 180 deg F (82 deg C)**] [**150 psig (1035 kPa)**] [**250 psig (1725 kPa)**] **<Insert value>**.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a Watts Water Technologies company.
 - e. Wilkins.
 - f. Zurn Industries, LLC.
 - g. **<Insert manufacturer's name>**.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: [**125 psig (860 kPa) minimum at 180 deg F (82 deg C)**] [**150 psig (1035 kPa)**] [**175 psig (1200 kPa)**] [**300 psig (2070 kPa)**] **<Insert value>**.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. **<Insert manufacturer's name>**.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: [**150 psig (1035 kPa)**] **<Insert value>**.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products.
 - e. Victaulic Company.
 - f. **<Insert manufacturer's name>**.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: [**300 psig (2070 kPa) at 225 deg F (107 deg C)**] **<Insert values>**.

5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground [**copper tube**] [**and**] [**ductile-iron pipe**] in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level [**with 0.25 percent slope downward toward drain**] [**without pitch**] and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX tubing with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- V. Install thermometers on[**inlet and**] outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- W. 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."
- X. 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."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "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 for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. **[Square cut] [Roll]** groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Piping: Join according to ASTM D 2855.

- N. Joints for PEX Tubing: Join according to ASTM F 1807 for metal insert and copper crimp ring fittings and ASTM F 1960 for cold expansion fittings and reinforcing rings.
- O. Joints for PEX Tubing: Join according to ASSE 1061 for push-fit fittings.
- P. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type coupling.
 - 2. Fittings for **NPS 2 (DN 50)** and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping **NPS 2 (DN 50)** and Smaller: Plastic-to-metal transition **[fittings]** **[or]** **[unions]**.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for **[NPS 2 (DN 50)]** <Insert pipe size> and Smaller: Use dielectric **[couplings]** **[couplings or nipples]** **[nipples]** **[unions]**.
- C. Dielectric Fittings for **[NPS 2-1/2 to NPS 4 (DN 65 to DN 100)]** <Insert pipe size range>: Use dielectric **[flanges]** **[flange kits]** **[nipples]**.
- D. Dielectric Fittings for **[NPS 5 (DN 125)]** <Insert pipe size> and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. **100 Feet (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Feet (30 m)** if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs **100 Feet (30 m)** 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 (10 mm)**.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. **NPS 3/4 (DN 20)** and Smaller: **60 inches (1500 mm)** with **3/8-inch (10-mm)** rod.
 2. **NPS 1 and NPS 1-1/4 (DN 25 and DN 32)**: **72 inches (1800 mm)** with **3/8-inch (10-mm)** rod.
 3. **NPS 1-1/2 and NPS 2 (DN 40 and DN 50)**: **96 inches (2400 mm)** with **3/8-inch (10-mm)** rod.
 4. **NPS 2-1/2 (DN 65)**: **108 inches (2700 mm)** with **1/2-inch (13-mm)** rod.
 5. **NPS 3 to NPS 5 (DN 80 to DN 125)**: **10 feet (3 m)** with **1/2-inch (13-mm)** rod.
 6. **NPS 6 (DN 150)**: **10 feet (3 m)** with **5/8-inch (16-mm)** rod.
 7. **NPS 8 (DN 200)**: **10 feet (3 m)** with **3/4-inch (19-mm)** rod.
- F. Install supports for vertical copper tubing every **10 feet (3 m)**.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. **NPS 1-1/4 (DN 32)** and Smaller: **84 inches (2100 mm)** with **3/8-inch (10-mm)** rod.
 2. **NPS 1-1/2 (DN 40)**: **108 inches (2700 mm)** with **3/8-inch (10-mm)** rod.
 3. **NPS 2 (DN 50)**: **10 feet (3 m)** with **3/8-inch (10-mm)** rod.
 4. **NPS 2-1/2 (DN 65)**: **11 feet (3.4 m)** with **1/2-inch (13-mm)** rod.
 5. **NPS 3 and NPS 3-1/2 (DN 80 and DN 90)**: **12 feet (3.7 m)** with **1/2-inch (13-mm)** rod.
 6. **NPS 4 and NPS 5 (DN 100 and DN 125)**: **12 feet (3.7 m)** with **5/8-inch (16-mm)** rod.
 7. **NPS 6 (DN 150)**: **12 feet (3.7 m)** with **3/4-inch (19-mm)** rod.
 8. **NPS 8 to NPS 12 (DN 200 to DN 300)**: **12 feet (3.7 m)** with **7/8-inch (22-mm)** rod.
- H. Install supports for vertical steel piping every **15 feet (4.5 m)**.
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. **NPS 1-1/4 (DN 32)** and Smaller: **84 inches (2100 mm)** with **3/8-inch (10-mm)** rod.
 2. **NPS 1-1/2 (DN 40)**: **108 inches (2700 mm)** with **3/8-inch (10-mm)** rod.
 3. **NPS 2 (DN 50)**: **10 feet (3 m)** with **3/8-inch (10-mm)** rod.
 4. **NPS 2-1/2 (DN 65)**: **11 feet (3.4 m)** with **1/2-inch (13-mm)** rod.
 5. **NPS 3 and NPS 3-1/2 (DN 80 and DN 90)**: **12 feet (3.7 m)** with **1/2-inch (13-mm)** rod.
 6. **NPS 4 and NPS 5 (DN 100 and DN 125)**: **12 feet (3.7 m)** with **5/8-inch (16-mm)** rod.
 7. **NPS 6 (DN 150)**: **12 feet (3.7 m)** with **3/4-inch (19-mm)** rod.
 8. **NPS 8 to NPS 12 (DN 200 to DN 300)**: **12 feet (3.7 m)** with **7/8-inch (22-mm)** rod.
- J. Install supports for vertical stainless-steel piping every **15 feet (4.5 m)**.

- K. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- L. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- M. Install vinyl-coated hangers for PEX tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
- N. Install hangers for vertical PEX tubing every 48 inches (1200 mm).
- O. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 2. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- P. Install supports for vertical PVC piping every 48 inches (1200 mm).
- Q. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- R. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.

- S. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. 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 that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for **NPS 2-1/2 (DN 65)** and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

- 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of **50 psig (345 kPa)** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least **50 ppm (50 mg/L)** of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least **200 ppm (200 mg/L)** of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. 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. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

- D. Under-building-slab, domestic water, building-service piping, **[NPS 3 (DN 80) and smaller]** **<Insert pipe size range>**, shall be **[one of]** the following:
1. Soft copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper pressure-seal fittings; and pressure-sealed]** joints.
 2. PVC, **[Schedule 40] [Schedule 80]**; socket fittings; and solvent-cemented joints.
 3. PP, **[SDR 7.4] [SDR 11]** socket fittings; and fusion-welded joints.
- E. Under-building-slab, domestic water, building-service piping, **[NPS 4 to NPS 8 (DN 100 to DN 200) and larger]** **<Insert pipe size range>**, shall be **[one of]** the following:
1. Soft copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; wrought-copper, solder-joint fittings; and brazed joints.
 2. Mechanical-joint, ductile-iron pipe; **[standard-] [or] [compact-]**pattern, mechanical-joint fittings; and mechanical joints.
 3. Push-on-joint, ductile-iron pipe; **[standard-] [or] [compact-]**pattern, push-on-joint fittings; and gasketed joints.
 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 5. PVC, **[Schedule 40] [Schedule 80]**; socket fittings; and solvent-cemented joints.
 6. PP, **[SDR 7.4] [SDR 11]** socket fittings; and fusion-welded joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, **[NPS 6 to NPS 12 (DN 150 to DN 300)]** **<Insert pipe size range>**, shall be **[one of]** the following:
1. Mechanical-joint, ductile-iron pipe; **[standard-] [or] [compact-]**pattern, mechanical-joint fittings; and mechanical joints.
 2. Push-on-joint, ductile-iron pipe; **[standard-] [or] [compact-]**pattern, push-on-joint fittings; and gasketed joints.
 3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, **[NPS 2 (DN 50) and smaller]** **<Insert pipe size range>**, shall be **[one of]** the following:
1. **[Hard] [or] [soft]** copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)**; **[wrought-copper, solder-joint fittings; and brazed] [copper pressure-seal-joint fittings; and pressure-sealed]** joints.
 2. PVC, **[Schedule 40] [Schedule 80]**; socket fittings; and solvent-cemented joints.
 3. PP, **[SDR 7.4] [SDR 11]** socket fittings; and fusion-welded joints.
- H. Aboveground domestic water piping, **[NPS 2 (DN 50) and smaller]** **<Insert pipe size range>**, shall be **[one of]** the following:
1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

2. Hard copper tube, [**ASTM B 88, Type L (ASTM B 88M, Type B)**] [**ASTM B 88, Type M (ASTM B 88M, Type C)**]; [**cast-**] [**or**] [**wrought-**]copper, solder-joint fittings; and [**brazed**] [**soldered**] joints.
 3. Hard copper tube, [**ASTM B 88, Type L (ASTM B 88M, Type B)**] [**or**] [**ASTM B 88, Type M (ASTM B 88M, Type C)**]; copper pressure-seal-joint fittings; and pressure-sealed joints.
 4. Hard copper tube, [**ASTM B 88, Type L (ASTM B 88M, Type B)**] [**or**] [**ASTM B 88, Type M (ASTM B 88M, Type C)**]; copper push-on-joint fittings; and push-on joints.
 5. CPVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 7. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.[**NPS 1-1/2 (DN 40) and NPS 2 (DN 50) CPVC pipe with CPVC socket fittings may be used instead of tubing.**]
 8. PEX tube, **NPS 1 (DN 25)** and smaller.
 - a. Fittings for PEX tube:
 - 1) ASTM F 1807, metal insert and copper crimp rings.
 - 2) ASTM F 1960, cold expansion fittings and reinforcing rings.
 - 3) ASSE 1061, push-fit fittings.
 9. PE-AL-PE tube, **NPS 1 (DN 25)** and smaller; fittings for PE-AL-PE tube; and crimped joints
 10. PEX-AL-PEX tube, **NPS 1 (DN 25)** and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
 11. PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 12. PP, [**SDR 7.4**] [**SDR 11**] socket fittings; and fusion-welded joints.
- I. Aboveground domestic water piping, [**NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**] <Insert pipe size range>, shall be[**one of**] the following:
1. Hard copper tube, [**ASTM B 88, Type L (ASTM B 88M, Type B)**] [**ASTM B 88, Type M (ASTM B 88M, Type C)**]; [**cast-**] [**or**] [**wrought-**]copper, solder-joint fittings; and [**brazed**] [**soldered**] joints.
 2. Hard copper tube, [**ASTM B 88, Type L (ASTM B 88M, Type B)**] [**or**] [**ASTM B 88, Type M (ASTM B 88M, Type C)**]; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, [**ASTM B 88, Type L (ASTM B 88M, Type B)**] [**or**] [**ASTM B 88, Type M (ASTM B 88M, Type C)**]; grooved-joint, copper-tube appurtenances; and grooved joints.
 4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 5. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 6. CPVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 7. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 8. PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 9. PP, [**SDR 7.4**] [**SDR 11**] socket fittings; and fusion-welded joints.
- J. Aboveground domestic water piping, [**NPS 5 to NPS 8 (DN 125 to DN 200)**] <Insert pipe size range>, shall be[**one of**] the following:

1. Hard copper tube, [ASTM B 88, Type L (ASTM B 88M, Type B)] [ASTM B 88, Type M (ASTM B 88M, Type C)]; [cast-] [or] [wrought-]copper, solder-joint fittings; and [brazed] [soldered] joints.
 2. Hard copper tube, [ASTM B 88, Type L (ASTM B 88M, Type B)] [or] [ASTM B 88, Type M (ASTM B 88M, Type C)]; grooved-joint, copper-tube appurtenances; and grooved joints.
 3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 5. Stainless-steel [Schedule 10] [Schedule 40] pipe, grooved-joint fittings, and grooved joints.
 6. CPVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
 7. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 8. PVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
- K. Aboveground, combined domestic water-service and fire-service-main piping, [NPS 6 to NPS 12 (DN 150 to (DN 300))] <Insert pipe size range>, shall be[one of] the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 4. Stainless-steel [Schedule 10] [Schedule 40] pipe, grooved-joint fittings, and grooved joints.

3.13 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 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: [Calibrated] [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.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116